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THE JOURNAL OF
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THE CORRELATION BETWEEN COLLEGE GRADES AND THE ALPHA INTELLIGENCE TESTS*

J. W. BRIDGES

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In October, 1919 the Army Intelligence Test Alpha was administered to five thousand nine hundred and fifty students at the Ohio State University. This study of the correlation between college grades and the scores on the Alpha examination and the various tests thereof, was made on the basis of the data thus obtained.

For purposes of correlation, samples were selected from the various classes and colleges in proportion to the total number of students in these groups. There were seven hundred and sixty seniors examined. From these a random sample of two hundred was selected by drawing approximately every fourth card from the files for seniors. Thus the College of Agriculture with a total of one hundred and thirty-eight seniors examined furnished thirty-six cases, the College of Arts with a total of one hundred and twenty-four seniors examined furnished thirty-one cases, and so on for others. In the same way one hundred juniors and one hundred sophomores were selected at random from their classes. In the case of the graduate students only those were selected whose under-graduate records were available. This group consisted of only thirty-six cases.

The academic standing of each of these students was determined in the following way. Records of the number of hours of each grade, M, G, A, P, and F were obtained from the registrar's office. These grades were reduced to a quantitative basis by means of the university point credit system. Each credit hour of M (merit) was weighted by multiplying it by 2; each credit hour of G (good) by 1.2; each credit hour of A (average) by 1; each credit hour of P (poor) by .8;

*Paper read before the American Psychological Association, Chicago, Dec., 1920.

and each F grade (failure) was multiplied by 0. The sum of the points credit thus obtained was divided by the total hours credit. A single numerical value representing the student's academic status resulted. This value may be called the *point-hour ratio.* A point-hour ratio of 1.00 will indicate a student of average academic standing, and deviations above or below this ratio will indicate corresponding deviations above or below the average in college grades. The following student record will illustrate the derivation of the point-hour ratio:

Semester	Grades					Total
	F	P	A	G	M	
I	..	13	4	....	....	17
II	..	3	1	6	....	10
III	..	6	8	....	5	19
IV	..	....	6	....	5	11
V	..	8	10	3	....	21
VI	..	11	1	7	....	19
VII	..	....	7	6	4	17
VIII	..	....	3	5	7	15
Hours	..	41	40	27	21	129
Weighting	0	.8	1.0	1.2	2.0	
Points credit	0	32.8	40	31.4	42	145.2

Point-Hour Ratio 145.2 ÷ 129 = 1.19.

The scores of the entire student body on the intelligence test (Army Alpha) range from 27 to 211 points. These scores were converted into percentile ranks. The percentile rank of a student is the percentage of the whole student body that he exceeds in his performance on the test. The percentile ranks of our sample of four hundred and thirty-six students were used instead of the raw scores in the study here reported. Our first problem is thus to determine the relationship between percentile ranks and point-hour ratios.

This relationship in the case of our four hundred and thirty-six students is shown in the correlation array, Table I. The most striking thing about this table is the large number of cases in the upper left hand quadrant. This means that many students of high intelligence get low academic scores. It will be noted that some fewer students of low intelligence (as measured by Army Alpha) attain comparatively high academic scores. Nevertheless, the general trend

of the cases shows a positive relationship. The Pearson Product-Moment Correlation is .35, as determined by the formula

$$\frac{\sigma_x{}^2 + \sigma_y{}^2 - \sigma^2{}_{(x-y)}}{2\sqrt{\sigma^2{}_x \cdot \sigma^2{}_y}}$$

TABLE I

Correlation between intelligence and scholarship

Percentile rank (Alpha)	Point-Hour ratio																Number cases
	30 39	40 49	50 59	60 69	70 79	80 89	90 99	100 109	110 119	120 129	130 139	140 149	150 159	160 169	170 179	180 189	
95–100	...	...	...	...	...	4	2	7	4	7	6	1	1	1	1	1	35
90–94	...	...	...	...	1	3	7	3	3	3	3	3	1	2	...	...	29
85–89	...	...	...	...	2	3	6	9	1	2	2	3	1	1	...	...	30
80–84	...	...	...	...	2	...	8	7	6	4	4	1	2	...	...	...	34
75–79	...	...	...	...	2	1	4	8	3	5	...	1	...	2	...	...	26
70–74	...	...	...	1	...	4	5	4	3	2	3	3	...	...	...	1	26
65–69	...	...	...	...	1	4	1	3	3	1	...	...	...	...	...	...	13
60–64	...	...	...	2	...	3	6	6	3	2	3	1	1	...	...	...	27
55–59	...	...	...	1	2	4	5	7	5	2	3	...	...	...	...	...	29
50–54	...	...	...	...	1	1	2	12	...	...	1	...	...	...	...	...	17
45–49	...	...	1	...	...	2	4	6	1	2	...	...	1	.	...	...	17
40–44	...	...	...	...	2	2	6	7	3	...	...	...	...	...	...	...	20
35–39	1	...	...	...	2	3	8	5	1	...	2	1	...	...	...	...	23
30–34	...	...	...	...	...	5	4	1	1	1	...	...	1	...	...	...	13
25–29	...	...	...	1	...	5	5	2	2	2	...	...	...	...	...	...	17
20–24	2	1	...	...	...	2	6	7	...	1	...	...	...	...	...	...	19
15–19	...	...	...	...	...	2	9	1	...	...	...	...	...	...	...	...	12
10–14	...	...	...	...	3	6	5	5	...	2	1	...	...	...	...	...	22
5–9	...	...	...	...	...	4	8	4	3	...	...	...	...	...	...	...	19
0–4	...	...	...	...	...	5	1	2	...	...	...	...	...	...	...	...	8
Number cases.....	3	1	1	5	18	63	102	106	42	36	28	14	8	6	1	2	436

On the basis of the intelligence test, the students in the University were grouped into five classes as follows:

Class	Points	Approximate Percentage in each Class
I	178–212	5
II	155–177	20
III	115–154	50
IV	85–114	20
V	0–84	5

The relationship between the intelligence class attained and the point-hour ratio is shown in Table II. The percentage distribution of academic grades for students of each class is given. F and P mean

that the point-hour ratio for these cases is less than 1.00, A means that it is 1.00 to 1.19, and G and M mean that it is 1.20 or higher. The number of cases in each class is also given. Classes I and V contain the total number of students in these classes for whom grades could be obtained. Classes II, III and IV contain only students from the above mentioned sample of four hundred and thirty-six cases.

TABLE II

Percentage distributions of academic grades for students of each class

Class	F and P	A	G and M	Number of cases
I	25.1	32.2	42.7	274
II	32.8	33.6	33.6	119
III	46.6	37.1	18.3	202
IV	66.7	27.8	5.5	72
V	88.3	8.4	3.3	274

The relationship between scholarship and intelligence may also be shown by presenting a percentage distribution of intelligence ratings for each academic grade. This is given in Table III. The grades F and P, and the grades G and M are combined as before. The distributions for the academic grades are based upon the sample of four hundred and thirty-six cases. The distribution for the whole university is given in the first row of the table, and there are also added for comparison intelligence distributions of students elected to Phi Beta Kappa in 1920, and of students placed on probation at the end of the first semester because of poor academic work.

TABLE III

Percentage distributions of intelligence ratings for students of different academic grades.

Intelligence rating	V	IV	III	II	I	Number cases
Whole University.....	5.0	20.0	50.0	20.0	5.0	5950
Phi Beta Kappa.....	.0	.0	39.3	35.7	25.0	28
G & M.....	.0	4.2	34.7	42.1	19.0	95
A.....	1.3	13.5	50.7	27.0	7.5	148
F & P.....	3.1	24.9	48.7	20.2	3.1	193
Probation.....	11.6	28.4	44.7	13.6	1.7	588

A study of the relationship between intelligence and academic status in the case of students of different ranks was next taken up. Our sample of four hundred and thirty-six students was divided into five groups: a group of thirty-six graduates, two groups of seniors of one hundred students each, a group of one hundred juniors, and a group of one hundred sophomores. Product-moment correlations were calculated separately for each of these groups with the following results: Thirty-six graduates, .15; first sample of one hundred seniors, .38; second sample of one hundred seniors, .35; one hundred juniors, .29; one hundred sophomores, .29. The higher correlation in the case of the seniors may be due to the fact that the point-hour ratios of these students were calculated from six semesters' work; but, on the other hand, the correlation for the thirty-six graduates whose point-hour ratios were calculated from eight semesters' work, is lowest of all. This may probably be accounted for by the very limited number of cases.

These results compare very favorably with the correlations between grades and scores on intelligence tests that have been obtained in many previous studies of pupils in primary and secondary schools. The figures obtained are decidedly significant, especially when it is remembered that college grades depend upon many factors in addition to intelligence, for example, interest, perseverance, and so on. Our correlations are however lower than those obtained by other investigators with college students. H. T. Hunter[1] reports a correlation of .52 between the Alpha intelligence test scores and college grades in the case of one hundred and fifty-nine women students in Southern Methodist University. S. S. Colvin[2] of Brown University also reports correlations between the Army test and college marks as follows: Army test and marks of first semester, .44; army test and marks of second semester, .39; and army test and average marks of two semesters, .45. These differences may be due to differences in the group studied (such as degree of homogeneity), or to the method of marking, method of weighting college grades to obtain numerical scores, and so on.

Our next problem was to determine the correlation between point-hour ratios and each of the tests in the army alpha examination taken

[1] Hunter, H. T.: Intelligence Tests at Southern Methodist University. *School and Society*, 10, 437–440, Oct., 1919.

[2] Colvin, S. S.: Psychological Tests at Brown University. *School and Society*, 10, 27–30, July, 1919.

separately. It seemed best to use for this purpose our two hundred senior students, since for these the point-hour ratio is based upon six semesters' work, and has therefore greater validity as a measure of academic standing. The results are given along with other correlations in Table IV. The correlations vary from .17 in the case of Test 3 to .37 in this case of test 7.

It might be supposed that the relatively lower correlations for tests 1 and 3 are partly due to the fact that these tests are too easy, and consequently not sufficiently discriminative of the kind of ability they aim to measure. In order to try out this supposition, those students who attained percentile rankings on the entire examination of 75 or above were eliminated from our four hundred and thirty-six cases, and correlations between point-hour ratios and scores on each of these tests were determined for the remaining cases (two hundred and ninety). The results were the reverse of those expected. The correlation in the case of Test 1 dropped to .02, and in the case of Test 3 to .07.

In view of the apparent diversity in subject matter and teaching methods, it seemed desirable to determine the correlation between grades and the Alpha examination in certain colleges of the university taken separately. In our sample of four hundred and thirty-six cases there were in all one hundred and six Arts students, eighty-seven Engineering students, and seventy Agriculture students. Product-moment correlations were determined for each of these groups between point-hour ratios and percentile ranks on the entire examination, and also between point-hour ratios and scores on each of the sub-tests separately. The results are given in Table IV.

The most noteworthy point brought out by these results is that the examination as a whole gives a much higher correlation with academic standing in the college of Agriculture than in either of the other colleges. This would be explained, if we assume that the students in the college of Agriculture are more closely supervised, and consequently work nearer the limit of their ability than in either of the other colleges. This is no doubt true of Agriculture as compared with Arts, but in the case of the Engineering students it is certainly not so evident.

If we turn to the correlation for the separate Alpha tests, we note a considerable variability from one college to another. Test 2, Arithmetic, gives the highest correlation with point-hour ratios in the case of Engineering students. This might have been expected from the nature of the test. Test 4, synonym-antonym, gives a fair correlation in the case of Arts and Agriculture students, but zero in the case of

Engineering students. Test 6, number series completion, gives zero correlation in the case of Arts students, and small positive correlations for the others. Tests 7 and 8, analogies and general information, give decidedly higher correlations in the case of students in the college of Agriculture.

These surprising results seem to demand corroboration by correlations with other samples. For this purpose point-hour ratios were obtained for all senior students in the colleges of Arts, Agriculture, Engineering and Education. Correlations were then computed as before with percentile ranks on Alpha and with scores on each of the sub-tests. These results are also presented in Table IV. They vary in some respects from those at first obtained; but the findings regarding tests 2, 4 and 6 are corroborated.

It is difficult to draw definite conclusions from these figures. They seem to indicate that tests 1, 3, and probably 6 should be improved or eliminated from the scale if a basis for the prediction of college grades is desired. They also appear to show that tests for university students should be selected and standardized for the various colleges separately; or, that *in addition to a general intelligence test for all students there should be specific tests for the students of different colleges.*

TABLE IV

Correlations between academic standing and army alpha tests

Group	Seniors Random	Agriculture		Arts		Engineering		Education Seniors	Average
		Random	Seniors	Random	Seniors	Random	Seniors		
No cases.....	200	70	132	106	81	87	135	66	
Alpha scores.	.35	.54	.39	.27	.35	.22	.25	.52	.36
Test 1.....	.18	.17	.21	.14	.08	.10	.05	.32	.16
Test 2.....	.22	.23	.34	.22	−.10	.38	.34	.39	.25
Test 3.....	.17	.28	.20	.15	.19	−.04	.21	.19	.17
Test 4.....	.27	.49	.32	.33	.37	−.16	.26	.55	.30
Test 5.....	.27	.45	.15	.20	.36	.19	.12	.15	.24
Test 6.....	.34	.31	.11	−.01	.05	.15	.28	.40	.20
Test 7.....	.37	.41	.27	.13	.26	.12	.09	.46	.26
Test 8.. ...	.31	.50	.28	.14	.27	.15	.21	.42	.29

AN APPROACH TO THE SYNTHETIC STUDY OF INTEREST IN EDUCATION: PART II

DOUGLAS WAPLES

Tufts College

Chapter Two. The Nature of Interest

Interest as a state of consciousness—the first of the three aspects to be considered—is implied by, if not included in, the phenomena of attention. The physiological approach to the study of interest must underlie all other approaches, since "The physiological conditions of the brain's activities are the first modifiers of feeling and action."[1] Only so far as the attentive process is understood in its relation to various types of experience can the nature and development of individual interest be explained by the effects of such experience. Both outer stimuli and inner structure are involved. The attentive process must accordingly be considered for two purposes: first, in order to obtain a working conception of interest-attention as depending largely upon environmental factors; and, secondly, to identify various phenomena of interest with physiological processes by which these phenomena are conditioned.

The wide difference of expert opinion as to the distinction between attention and interest is proof that no clear distinction exists.[2] Yet some such distinction is required if environmental stimuli are to be so related to organic processes that the effect of each is apparent in the normal expression of interest. As best suiting this purpose the distinction may therefore be made on the basis of relativity. Such factors of the interest-attention state as are more largely organic and hence constant in their effects upon various normal individuals may be identified with attention. Such factors as are largely environmental and hence variable in their effects may be identified with interest. Attention, thus conceived results largely from nature, and interest from nurture. The former implies the capacity to attend, and the latter the direction of such capacity by the creation of desires and aversions through contact with environment.

This distinction between absolute and relative factors in the same state of consciousness serves the first purpose outlined above by

[1] E. L. Thorndike: "Educational Psychology," III : 308.

[2] *cf.* E. B. Titchener: "Psychology of Feeling and Attention," pp. 294ff. for views of Ebblinghaus, Pillsbury, Stout, and Wundt.

suggesting a correspondence between types of interest and types of attention. Such correspondence is clearly helpful in the attempt to explain differences in mental process as determined by differences in environment. The reference to "types" of attention suggests that the modern *analysis* of the state under the heads of span, concentration, distribution, etc. is to be abandoned in favor of the older *classification*—involuntary, non-voluntary, and voluntary (McDougall), or sensorial and intellectual (James), or emotional and volitional (Meumann), etc. The classification has the advantage in the present instance of including all the factors capable of analysis in addition to other factors implied in a given state and yet incapable of differentiation. The classification accepted by McDougall as above[1] is further useful in that the distinction between types of attention is based on the motor and neural processes involved. The relation of organic structure to environmental differences is thereby greatly facilitated provided that some connection can be established between types of attention and types of interest, the latter to be distinguished by the class of situations or of objects attended to.

The simplest means of arriving at this correspondence between types of attention and of interest is to note the effects of each type of attention in the expression of interest. The course of expression at any stage of development proceeds from a relatively less satisfying state of consciousness and seeks a relatively more satisfying state. The mechanical or motory process of the seeking is attention, and interest yields the feeling of satisfaction or dissatisfaction.[2] Hence it is evident that the distinction between types must depend primarily upon the nature of the object which determines the course of seeking. Certain classes of objects which provoke relatively more intense feelings of satisfaction or dissatisfaction serve also to select those motor processes best able to produce the desired effect. The effects of involuntary, non-voluntary, and voluntary attention may thus be noted as resulting from intensity of stimulus. It is obvious that the distinction between types is rather one of degree than of kind.

The characteristic effect of involuntary attention is fixation, or placing the object in such position that a clearer view is obtained. The physical sub-processes implied result in the better adjustment of the sense organs, movements to or from the object, and instinctive analysis of it. The type is chiefly distinguished by the motor element,

[1] *Mind N. S.*, XI: 319, Note 1.

[2] *cf.* W. Mitchell: "The Structure and Growth of the Mind," pp. 90ff.

which is reflex or instinctive. The adjustment is entirely effortless and no feelings of inhibition are apparent.[1] This fact justifies the assumption that involuntary attention which persists appreciably beyond the reaction time is commonly aroused only by situations of relatively maximum intensity. Such situations demanding immediate response are referred directly to the instinctive mechanism without risking the delay involved in judgment. This directness of response resulting from maximum intensity of stimulus is also characteristic of the intrinsic type of interest which seeks indulgence in feeling as such. It finds expression in such varieties of interest as are based in qualities of objects that are intense in themselves; as, for example, novelty, contrast, repetition, movement, rhythm and other qualities leading to states of absorption. Involuntary attention and intrinsic interest are both implied in sensori-motor experiment and in response to strong stimuli.

The normal effect of non-voluntary attention is merely a later phase of the fixation process which occurs when the desired state is not promptly attained. This effect has been termed mental manipulation. It consists in a revolving, analysis, and comparison of the situation with others. The ideo-motor process which controls the course of seeking is based on experience of earlier reflex movements. Action involves scarcely more effort than when attention is involuntary. Here again the effect of attention is to provide the means for the realization of interest which in this case seeks a change rendered desirable by previous rather than present experience. Its commoner expressions reveal interest in the overcoming of obstacles. Such interest is properly classified as practical since it includes such varieties as find expression in outer imitation, pursuit, and all forms of rivalry upon which the survival of the organism most directly depends. Intensity is lower than in expressions of intrinsic interest since the course of seeking is less immediately satisfying in itself. Interest in the pure stimulus is greater than interest in the object to be resisted. Thus the simultaneous appearance and scope of both non-voluntary attention and practical interest in all habitual behavior suggests a correspondence between these types.

The effect of voluntary attention is continued scrutiny of the object. Action is impeded by the necessity for selection of the best means from all means available. Neural dispositions resulting from past experi-

[1] Though the factor of inhibition is doubtless involved as suggested by Sherrington: "Integration of the Nervous System."

ence must be successively inhibited. Hence the process might last indefinitely, but for the factor of fatigue and changes in the object itself which may bring relief in action before the difficulty has been solved. In this course of seeking, interest implies the revival of and selection from all relevant ideas that may further the realization of useful knowledge. Such interest may therefore be classified as cognitive or intellectual and said to correspond with voluntary attention. It should however be noted that in cognitive interest the nisic character of the attentive state is of very brief duration. The slow rhythm and fluctuation characteristic of voluntary attention may reduce the intensity to such a point that attention dies,—and with it very frequently the interest. Or else success in solving one aspect of the problem before attention may introduce practical or intrinsic elements to the existing variety of interest which serve to increase the intensity,—often so as to render attention non-voluntary or involuntary. Hence the inhibitory effect of voluntary attention need last only long enough to admit other types of interest.

Otherwise stated, attention to any object or situation provides the means by which one or more types of interest may be realized. Particular sub-processess involved in the course of seeking are selected by the immediacy of response required, which depends upon the intensity of interest determined by the type of experience. The situation may stimulate in order to obtain emotional satisfaction, thus revealing intrinsic interest; or attention may seek to overcome a physical difficulty,—the practical type of interest; or in order to understand the situation for future usefulness,—the cognitive type of interest. It should be further noted that each attitude toward environment, as indicated by type of interest, includes more specific "varieties," which are later to be considered in discussing the growth of interest. Several such varieties are common to all types of interest,—for example interest in achievement or social superiority, which follows the realization of all interest and is the affective equivalent of organic processes making for self-preservation. Even when inattentive or involuntarily attentive, this interest in achievement consists in the felt attitudes to aspects not attended to and in the exercise of the senses. Ideo-motor non-voluntary attention reveals this interest in successful performance of habitual acts; voluntary attention in the realization of one or more specific interests in the problem. Such specific interests illustrate the shifting of types. Voluntary attention may seek to realize interest in achievement by the possession of fuller feeling and appreciation, *i.e.*,

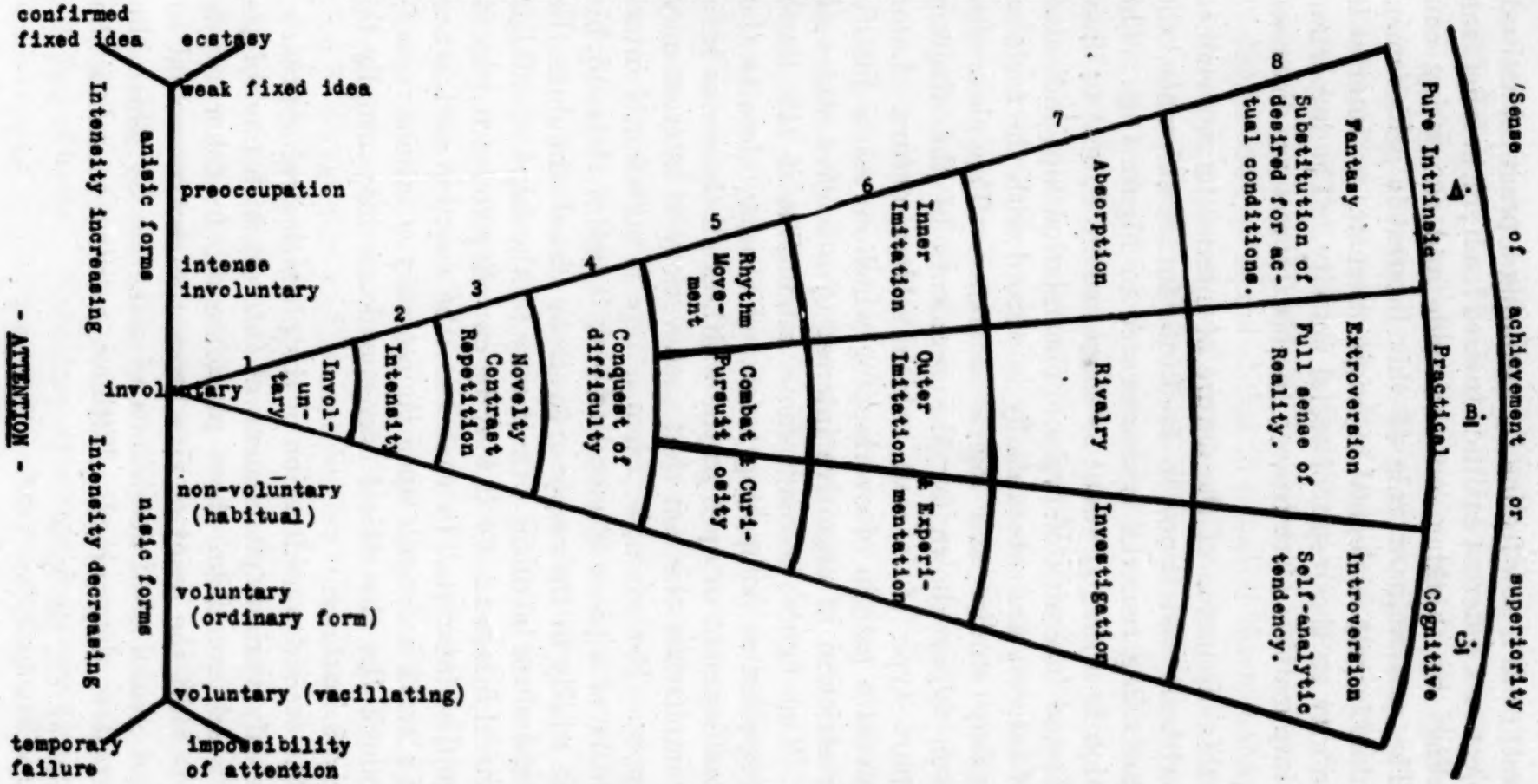
intrinsic interest; or in a new feeling by assuming a practical attitude toward the object or a different attitude toward itself; or in relief from conflicting feelings by thinking out each side and comparing consequences.[1] The predominant role of this interest in achievement found in impulses largely biological in origin, becomes an interest in personal superiority as the result of social activity. The important psychological implications of resistance to this interest are discussed in a later chapter.

To clarify this discussion of the nature of interest as determined largely from without and hence to facilitate future reference, the substance of preceding remarks is represented in Figure One. The scale of attention is arranged about as suggested by Ribot[2] to illustrate the graduated intensity of types. The relationships indicated in the chart of interest are substantially in accord with the facts as recorded by group studies and logical inference. The clear distinction between types shown by the segments of the diagram postulates a pure type of interest, which seldom occurs. Later analysis will reveal a margin of overlapping which serves to justify the apparent restriction of cognitive interest to attentive states of low intensity. The figure becomes more intelligible if the three segments are regarded as composing a fan, which may close to the width of any one segment or open to the width of all three—as here shown. This emphasizes the fact that each variety of interest may occur in all types. For example, when a boy is sufficiently interested in the glitter of a piece of metal to pick it out of the mud, his interest may lie wholly in the response to strong visual stimulus—the gleam—and is therefore intrinsic. Or it may be the hope of sudden wealth—a practical interest. Or it may be curiosity to learn why it gleams—a cognitive interest. In each case the reaction and hence the function of attention *depends upon the intensity of interest regardless of type,* though the theoretical correspondence may usually be justified in a given instance.

Passing to the second consideration of the physiological approach, we have to identify various phenomena of interest with physiological processes which condition these phenomena. In other words it is necessary to shift the point of view from the environmental to the organic and neurological conditions of attention by which the growth of interest is determined. Without pausing to relate the

[1] *cf.* W. Mitchell, *op. cit.*, pp. 95, 98.
[2] "Psychology of Attention," pp. 110ff.

Figure One. Illustrating Correspondence between Types of Attention and Interest and the Development of Interest as Expressed in Typical Behavior.



Explanation: Vertical scale indicates degrees of intensity of attention.

Segments A,B,C indicate types of interest which in pure form may be considered to vary in degree of intensity somewhat as indicated. Attention is labored in purely abstract thought and intense in purely aesthetic feeling, etc.

Arcs 1,2,3, and 4 indicate varieties of interest, i.e. general forms of expression, which occur in any type. Arcs 5,6,7, and 8 indicate varieties which tend to seek expression in appropriate types, thereby modifying the intensity of attention by causing the types to overlap. Such types are of course distinct only in abstraction; the expression of interest is normally distributed through various forms of behavior of which the above are merely typical.

many subsidiary factors of attention to the phenomena of interest,[1] it is well at least to mention those processes whose genetic development serves to explain stages in the development of interest. Such universal forms of expression as are mentioned in connection with the growth of interest (Chapter Three) will thus imply the physiological conditions characteristic of each stage of development. For this purpose a most casual reference will suffice.

Assuming familiarity with the treatments of Baldwin, Thorndike, and Wundt, we may postulate three stages of interest and suggest under broad headings the physiological factors most characteristic of each. As commonly distinguished[2] these stages are assigned roughly to the years birth to 9, 9 to 13, and 13 to maturity. The first may be termed experimental, implying interest in sensory and motor exercise for its own sake or for relatively insignificant ends. The second, or imitative stage, marks the appearance of aggressive and defensive social interests that show native biological tendencies in partial conflict with environment. The third or reflective stage, while of course including the features of the earlier stages, shows the individual largely identified with certain ends. Such interests may be said to have become habitual. While the expression of all interest is normally distributed over the range of development indicated by the three stages, these periods determined by the notion of neural arcs are helpful for purposes of classification.

The physiological basis of interest-attention may be referred to the combination of organic and neural processes. The organic must here be largely disregarded, yet their role in the effective expression of interest is fundamental. Motor, respiratory, and vaso-motor phenomena are essential constituents of every state. The genetic development of these organic processes is implied by capacity for rational choice, which involves conscious control of motor processes and to some extent of the respiratory. In a word, the stages of interest are marked by the appearance of various forms of movement. Reflex and instinctive, ideo-motor, and voluntary movements develop successively and imply greater capacity to profit by experience, as suggested in the preceding discussion of type. Since all forms of attention must appear in each stage and develop concom-

[1] McDougall offers a list of fifteen such factors which might profitably be so related. *Mind. N. S.*, XII: 317–8.

[2] By Adams: "Exposition and Illustration in Teaching," p. 54; Baldwin "Mental Development: Social and Ethical Interpretations," pp. 362ff; Croswell *loc. cit.;* et al.

itantly, the course of motor development toward voluntary inhibition is closely parallel. Certain reflex movements are valuable aids in the diagosis of unconscious interest. Others by mere expenditure of energy facilitate attention indirectly by arousing the motor centers, and directly by adjustment of the sense organs. Instinctive movements combine a series of reflex movements in a certain order which the ideo-motor process connects with an idea of the situation as a whole. Hence the effect of the movement upon the impression or idea is the important one of reinforcenemt by innervation. The idea can be more clearly distinguished if the related movement is actually made. The inhibitions of voluntary movement are likewise explained as the omission to reinforce ideas with undesirable associations. Such inhibitions involve the uncertain relation of interest to fatigue. The remark is probably safe that the degree of general fatigue inhibited varies directly, but within narrow limits. with intensity of affective tone.[1] Respiratory proces es, as determining in part the distribution of attention, develop similarly. The vaso-motor process, as regulating with other factors the supply of blood to the brain, determines also the intensity of the attentive state and is an important condition of definite association and reinforcement. As related to affective states these phenomena are perhaps most conveniently discussed by W. H. Howell's **Physiology** and the briefer treatment of F. Arnold's **Attention and Interest.**

Any adequate discussion of the neural process as determining the nature and growth of interest requires that recent conflicting theories of the apperceptive process be analyzed in the light of the most reliable behavioristic evidence. Such analysis is impossible here. Yet the nature of the inquiry may be suggested by the selection of the three widely accepted principles which McDougall declares to constitute the indispensible basis of physiological psychology; namely, the specific energies of sensory nerves, strict localization of cerebral functions, and the principle of association.[2] On the basis of these principles and their implications, the specific energies, *i.e.*, tendencies resulting from sensory or ideational stimulus, must occur in "the specific constitution of structural elements of the cerebral cortex that are capable of becoming associated together

[1] *cf.* Thorndike, *op. cit.*, pp. 120f. and C. S. Myers: "Introduction to Experimental Psychology," p. 107.

[2] "Introduction to Physiological Psychology," pp. 58f.

when thrown into simultaneous action."[1] The organization of these elements in functional groups, by which the nervous system evolves, is believed to consist in the formation and perfection of synapses which therefore determine both the direction and intensity of interest. This leads to a preliminary statement regarding the relation of feeling and knowledge, that intensity of the psychical process varies inversely with the complexity of neural organization, or knowledge. Psychical activity results when the resistance of the synapse to the neural current is high because of the novelty or infrequency of such currents—hence the affective value and interest in strong and unsual stimuli, surprise, etc. When the resistance of the particular synapses has been diminished by the frequent passage of the impulse, the intense psychic effect no longer appears. By voluntary reinforcement, however, impulses may be so directed through the complex systems of high intelligence that neither the resistance nor the resulting intensity is appreciably reduced. In this case the reinforcement merely functions with greater economy.

As distinguishing the hypothetical stages of interest and resulting from the successive development of neural arcs in systems of increasing complexity, three forms of reinforcement are implied: instinctive reaction to pleasure-pain, direct reproduction of neural systems associated by temporal contiguity, and divergent reproduction of such systems through derived associations. Certain implications of each form affecting the expression of interest may be briefly noted.

Highly stimulating objects, whether novel or sharply contrasted with the object in consciousness, can compel attention at all ages. In earliest childhood such objects produce and perfect the reflex movements whose control serves later to reinforce complex movements of the ideo-motor variety. Yet the state of involuntary attention resulting almost entirely from organic factors, in which they first appear, is without ideal reinforcement and consequently of very brief duration. Some form of reinforcement must exist to explain the tenure of such objects for even the fixation time, and this is found in sensations of pleasure-pain. Reinforced by such sensations—whether of sight, sound, taste, movement, et al.—attention persists and reveals the forward reference tendency apparent in higher forms of interest. In the case of mere sensory stimulation, the fact of attention may be ascribed to interest in the exercise of the organ stimulated. The stage of interest in such phenomena is accordingly quasi-organic or

[1] *Ibid.*

experimental. It is distinguished by the vagueness or absence of conscious aim.

Attention resulting from the factors of the cerebral level implies preperception, the ability to identify the object before consciousness with a mental image gained from former experience with it. Here the reinforcement results from association by temporal contiguity, which McDougall states "is the one and only form of association that can be explained physiologically."[1] Attention to any one element of the ideal disposition tends to reproduce the whole of a former experience. Selection from incoming impressions is guided by the reinforcement of such impressions as are almost entirely familiar. The constellation of mental states before the situation has entered consciousness seeks control by diffusion of energy in the direction suggested by the most familiar element in the situation. Suggestion is particularly potent in the direction of interest because of the ease with which familiar elements are dissociated. Likewise imitation of other's acts and reproduction of the child's own activities direct interest very largely and cause certain relationships to be taken-for-granted, thereby increasing the scope of interest. The stage implied by these processes may be termed the imitative or social stage as indicating tendencies to reproduce familiar experience. It is distinguished by complications of experimental interest resulting from social relationships. The characteristic aim is social superiority.

Reinforcement of voluntary attention is due largely to the complex interrelations in the neural systems of the frontal areas. The afferent impulse, instead of reproducing readily the constellations associated with it in time, diverges into a number of sub-systems related to the constellation. A conflict of tendencies results which can be resolved only by conscious deliberation. This successive inhibition of various means continues until an element of experience is revived which contains the solution or until the search fails. In the former case intermediate elements are referred to the ideo-motor processes and reinforced by temporal associations. In the latter case, the search is abandoned until the mind is recalled to the dilemma by dissatisfaction in the failure to control. In affective terms, the distinguishing feature of the process is desire for control through closer contact with reality as represented by previous experience. Expression of interest in this deliberative stage is characterized by mediation

[1] *Op. cit.*, p. 135.

between organic impulse and rational judgment. Sacrifice of either results in a repression of interest, the subject for a later discussion.

F. M. Alexander's recent work, *Man's Supreme Inheritance*, suggests that the phenomena of repression result from dissociation of the 'higher' from the 'lower' nervous centers. The implication is clearly that integration of neural function is essential to the most effective expenditure of effort, and the normal distribution of interest which such expenditure implies. Hence the deliberative stage of interest is distinguished by the variety of attitudes in which interest may find expression because of the numerous constellations in which thought of the given situation may occur. It is also marked by the tendency to act in certain interests which have become habitual.

In summary, it may be observed that the reference to certain more prominent physiological factors of interest has been developed by the three-fold classification proposed (Chapter One, 4). Under these heads both external and internal conditions are related to the most conspicuous phenomena of interest in such manner as should best help the discussion to follow. Abstract and rather arbitrary classification is necessary in order to emphasize common elements in various explanations of the same phenomena, hence none but the most general features are examined. Otherwise it would be possible to select from the wide field of studies to determine variations in the behavior of individuals and groups which this discussion is forced largely to ignore. From the evidence at present available the chief characteristic of such mental variations is their continuity. The intermediate stages are far commoner than the extreme types. Variations in the development of interest, perhaps the least constant of all mental traits, can therefore be recorded only within the limits of general tendencies.

Chapter Three. Development of Instinctive Interest

The science of genetic psychology postulates that mature behavior is largely traceable to original instinctive endowment. Behavior at various stages is explained by reference to the stage preceding. It is clear, however, that such explanation is as yet by no means complete, nor can it be until an inventory of native traits is made to tally at all points with the main tendencies of later conduct. Pending scientific selection and description of such traits and tendencies, this complete explanation is clearly utopian. One is thus forced to rely upon

opinion both in selecting instinctive traits and in distinguishing those later tendencies which the traits serve to explain. The abundance of expert opinion regarding continuity of instinctive development must be sifted by the most reliable evidence available, which is probably to be found in the many accurate descriptions of particular responses under various prescribed conditions.

Waddle states in this connection: "It is self evident that most of the interests are conditioned directly by instinctive emotional complexes. We cannot understand or anticipate interests, then, without an understanding of their inborn correlates."[1] For this reason it is easier to identify and classify the more constant varieties of interest when the behavior examined is closely restricted to activities of biological origin, for here conformity is greatest. Yet it is important that this approach should not obscure the distinction it is intended to emphasize; namely, the distinction between the instinctive basis itself as inferred from the child's responses and later interest-behavior which includes other than instinctive elements. The instinct for mere motor activities, for example, while explaining the fact of interest in movements does little to explain the nature of such interest as determined by the various ends sought. Yet the more nearly certain broad classes of interests, such as are indicated by the types before described, can be related to universal tendencies of instincts, the easier is it to mark off broad types of behavior in which related varieties of interest can be identified. To assist this relation of interest to instinct, the present discussion ignores social and other environmental elements of interest so far as possible, by considering only such expressions as occur in solitary play. Of these the most useful accounts are probably found in such familiar works as Chamberlain's *The Child*, Groos' *The Play of Man*,[2] and Preyer's *The Mind of the Child*. More particularized, and somewhat more scientific accounts of special forms of play are equally familiar in the various child-study publications. It is unfortunate that space forbids any description of evidence upon which a conclusive study of instinctive interest must rely. For this the reader is referred to certain original sources which illustrate the method of approach herein described.

This restriction of the field to largely non-social behavior is helpful in confining the discussion to interests of the experimental stage. It has

[1] "Child Psychology," p. 112.

[2] Pp. 7–118 of this work are closely followed in the remaining discussion of this chapter and pp. 173–334 in that of the chapter following.

however the disadvantage of excluding the phenomena of imitation appearing in the same period of development, which are reserved for later treatment as explaining social modifications of instinctive interest.[1] Experimental interests find fullest expression in play for the reason that playful activities are performed *per se*. Their relation to instinctive tendencies is therefore most close. Hence differences in type of instinctive function may serve to distinguish corresponding forms of play in which the type of interest is determined most directly by the instinctive function. Related varieties of interest can most readily be identified in these forms of play because of their development from a common instinctive source.

In most general terms, these types of instinctive function are two, the sensory and motor. By attaching sensory qualities to various objects instinct facilitates the satisfaction of organic needs,[2] and these responses to agreeable stimuli soon constitute the primary form of conscious play. The feeling of satisfaction or dissatisfaction is the source of all interest which later includes the progressive forms of feeling, affect, impulse, and desire.[3] Playful sensory exercise may thus be selected as the form of behavior which results most directly from interest of the intrinsic type, and the various qualities possessed by the stimuli of these sensations may accordingly be regarded as varieties of such interest. Instinctive motor activity of a sort is implied in all sensations, which reveals an "instinctive manipulation of things, movements to or from them, persistence against obstacles, and the restlessness that goes with a sense of want."[4] The pleasure of kinasthetic sensation soon produces such movements playfully as ends in themselves together with playful movements of foreign bodies. This second form of play is the logical province of experimental practical interest. In addition to these instinctive functions, a third may be predicated to account for the playful exercise of mental powers that reveals an experimental cognitive interest. This function first appears in the instinctive adjustment of sense organs to secure a fuller sensation. Its later activity in such plays as require the exercise of attention, imagination, and reason, as in guessing games, etc. is sufficiently great to justify the third division. These three progressive forms of play activity thus closely related to distinguishable instinctive

[1] *I.e.*, the transition from private to public interest, *cf.* Baldwin, *op. cit.*, p. 503.
[2] *cf.* W. Mitchell: *op. cit.*, p. 194.
[3] Wundt: *Philosophische Studien*, 6: 380.
[4] Mitchell, *op. cit.*, p. 105.

functions and clearly evident in all children's behavior require further brief comment in turn. The purpose of this comment is to indicate hypothetically the conclusions which a truly scientific study of instinctive interest might reach both as to the gradual differentiation of types of interest in this behavior and the more conspicuous varieties in each type.

The conspicuous varieties of intrinsic interest may be supposed to extend from undifferentiated pleasure-pain sensations through such qualities as intensity, novelty, contrast, movement, repetition, rhythm,—and to culminate in states of aesthetic absorption.[1] While the order is mainly conjectural, it is supported by such accounts of progressive response to the various sensations as is offered by Groos. Intensity, novelty, and contrast are qualities which serve to explain expressions of interest in all sensations but chiefly in those of contact, sight, sound, and smell.[2] Movement is of course here confined to visual sensations and results from the biological importance of attention to changes in environment. Interest in repetition appears chiefly in productive sound sensations. Rhythm as observed in the movements of others is interesting on account of the muscular innervations involved. Rhythmic sounds, from the watch-tick to band music, and melody at about four years, both excite a lively interest which is due largely to mild hypnosis.[3] In absorption this phenomenon is more apparent and is treated elsewhere in connection with inner imitation.

The gradual transition to the practical type may be illustrated by interest in the production of vocal sounds. From the mere acoustic sensation interest develops in overcoming the difficulty of articulation. This evolution of motor from sensory interest is typical of all playful behavior. From this point the normal varieties of practical interest may be tentatively listed as conquest-of-obstacles, control, pursuit, combativeness, outer-imitation or reproduction, and rivalry,—all culminating in achievement of highly particularized nature which is characteristic of all practical interest. As best expressed in playful bodily movements and movements of external objects, interest in conquest-of-obstacles appears in early attempts to sit, stand, or walk.

[1] Absorption is here interpreted as originally defined by Th. Lipps: *Zur Einfühlung*, Leipsig, 1913. It implies absorption *in* the stimulus, not *with* the stimlus as in the fixed idea.

[2] *cf.* Preyer: *op. cit.*, Chapter I.

[3] *cf.* Gates: "Musical Interests of Children," *Journal of Pedagogy*, 2: 265–284.

This comes rapidly to include control and pursuit motives [1] as in passive movements of coasting or in runs, hill-climbing, and hide-and-seek games.[2] Interest in control often renders such vocations as seamanship, fire fighting, and horse racing most attractive during the years 9–13.[3] Combative instincts bear much the same relation to interest in many forms of destructive or analytic play as outer imitation bears to constructive interest in mud-pies, snow-men, and even in collections.[4] Rivalry is evident in such collecting as in all behavior at the appropriate age. Its treatment as allied with interest in superiority is deferred to the later discussion of social interest. On the whole this relation between intrinsic and practical interest suggests the biological explanation of a familiar fact; namely, that motivation consists in the response to intrinsic stimulation which provokes voluntary effort toward a desired end. Such effort is rendered efficient by practical interest in achievement.

Experimental varieties of cognitive interest, as appearing in playful exercise of mental powers, may occur in recognition, expectancy, reproduction, reconstruction, curiosity, experiment, and—less clearly observed at this stage—investigation and judgment. As Kirkpatrick states, "If interests depended only upon the biologically useful instincts, there could be but little development of intellectual interest."[5] Yet it is only by instinctive exercise of mental powers in expression of practical interest that capacity for the so called "higher" interests is developed. Interest in the "warmth and intimacy" of mere recognition and also in expectancy may be termed wholly instinctive.[6] The memorizing and reproduction of nonsense syllables, etc. is largely of practical interest in the mere achievement, though some cognitive interest is implied. Interest in playful use of the imagination appears in reconstruction of past experience for indulgence in all forms of make-believe, as in stories told by and to children.[7] Curiosity, while at first seeking novel impressions rather than meaning for later use, marks the rise of real cognitive interest in the exercise of reason.[8]

[1] "No activity is interesting unless it follows the pursuit pattern," Jennings: "Suggestions of Modern Science," p. 164.

[2] *cf.* J. Lee, *op. cit.*, Chapter 26.

[3] *cf.* Crosswell, *op. cit.*

[4] *cf.* Groos, *op. cit.*, pp. 99ff. and Burk "Children's Collections," *Ped. Sem.*, 7: 179–207.

[5] "Individual in the Making," p. 18.

[6] Groos, *op. cit.*, p. 125, finds humor resulting from impeded recognition.

[7] J. Lee, *op. cit.*, *passim;* Barnes: "Studies in Education," I and II.

[8] *cf.* J. Welton: "Psychology of Education," p. 209; and Henderson: "Principles of Education," p. 254.

In plays with riddles, puzzles, tormenting animals, etc. interest passes from the post hoc to the propter hoc[1] and still later to plays with the feelings as in games of self-control and endurance and also in ghost stories.[2] Purposeful investigation and judgment involving higher physiological development need merely be mentioned as later forms of cognitive interest. The significant feature of cognitive interests is their brief duration in the pure type. When once expression is fairly under way other elements enter in to render the interest practical or even intrinsic.

These instinctive or experimental varieties of interest expressed in comparatively universal forms of behavior are next to be considered in their social complexity—as modified by processes of environmental adjustment.

[1] Davis: "Interest in the Causal Idea," *Child Study Monthly*, 2: 226.

[2] Groos, *op. cit.*, pp. 169ff. and Brewer: "Instinctive Interest in Bear and Wolf Stories," *Amer. Ass'n. for Advance of Science, Proceed.*, XVII.

JUDGMENT OF RELATIVE VALUES

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A sense of relative values is essential to the judgment process. "Unconscious premises," the precipitate of previous experience, are required in every complex judgment. These unconscious premises serve to weight the various factors which are pertinent to the problem under consideration.

Judgment in one form or another has been measured by a large number of the so-called mental tests. Bonser, Herring, and Cyril Burt, have done direct work on certain phases of the question. In the common sense test of the army intelligence examination, the procedure is to propound a question, to which four alternative answers are given. For subjects above a certain mental age, one of these answers usually is obviously correct, and the other three are often absurd. Under these conditions, the measurement of the sense of relative values is distinctly crude; the test can hardly be said to give any knowledge of the finer sense of relative values upon which judgments in history, civics, geography, literature and every-day living depend. In these last named, it is usually not a matter of one reason being right and the others wrong—the task is much more to decide, among a number of reasons, what must be the degree of importance attached to each. Thus, for example, in considering a question such as the value of capital punishment, upon which sophomoric genius has spent itself, the problem is not to decide that one reason is correct, and all the other reasons are incorrect, so much as it is to compare each reason with the other reasons, in an attempt to estimate its worth. In observing instruction in the higher grades, the author has been much impressed by the frequency with which the problem under discussion calls for this type of mental activity. On many occasions a pupil will give as a reason for a certain action or a certain state of affairs a reply which can be called neither right nor wrong. The reply has value and is a partial explanation, but its value is small compared with other reasons which the pupil himself is capable of giving, when pressed. The pupils seem to be moderately fertile in suggesting reasons. What is apparently lacking is either the disposition or the ability to weight the value of the various reasons. This phase of mental activity seems to be of sufficient importance to warrant considerable investigation. The object of the present

research is to obtain some information which will throw light on this complex type of judgment, a type of judgment perhaps more essential to success in life than it is to success in the present-day school.

In the common-sense test of the army intelligence examination, the scale of reasons given may be called discontinuous, in the limited sense that one reason is tolerably sound and the others more or less absurd. The general method of procedure in this study was to substitute for this discontinuous method a more continuous series of reasons, having all degrees of relevancy, from a high degree of validity to such low degree as to be absurd. For this purpose it was necessary to construct, for a number of topics, what virtually amounts to rough scales of relevancy, a process which has been made familiar by the construction of handwriting, drawing and composition scales.

A number of topics were selected, which, from their general nature, would be reasonably within the scope of elementary school-children, of Grade VI to Grade VIII. From a large number the following three topics were eventually chosen.

1. Reasons for Going to High School.
2. Reasons for Reading Good Literature.
3. Reasons for Saving.

The final selection of samples forming each scale follows:

The process of forming the scales for each of these topics will be made evident by considering in detail the method of developing the series called, "Reasons for Going to High School."

RELATIVE VALUES IN READING

Reasons for going to high school

A. One must not forget the lectures which are occasionally given in high school by prominent men, such as ministers, politicians, and educators; these often grip a pupil's mind and help him to decide his purpose in life.

B. Many high schools have pennants, trophies and pins, quite apart from the graduation diploma itself, without being in high school one cannot have these valuable things to show to neighbors and friends, both during high school and in after life.

C. One must find something to do to occupy the time; since the high school course keeps one so well occupied, every boy and girl should without fail attend the whole of the four year period as regularly as possible.

D. From the purely monetary point of view, it pays to attend high school; no individual can earn to the full extent of his capacity, if he has merely the resources which are given by an elementary education.

E. A high school education teaches one to co-operate, and to adjust one's self to others; it teaches one to keep one's own individuality and at the same time to show a proper respect for the opinions of others.

F. If one does not go to high school one is apt to disappoint the teachers with whom one has worked; this should be the last thing any pupil should dream of allowing to happen.

G. While the elementary school gives the tools of learning, the good high school goes further, for it teaches the sound use of the mother tongue, the habit of reflection, the power to grow, the art of transferring thought into action, and last but not least, refined and gentle manners.

H. Many boys and girls would have no systematic physical exercise whatsoever if they did not attend high school where physical training is compulsory: for this reason alone they should try to attend for the four year period.

"Reasons for Going to High School."

Sixty undergraduate students handed in five reasons each, so chosen as to range from a good reason to what would appear to an adult to be almost a stupid reason. Each student graded his reasons, according to his own judgment, from one to five. From the large number of roughly graded samples thus secured, thirty, which represented all degrees of relevancy, were selected. These thirty were then given to a small group of competent persons, for ranking. On the basis of this ranking, the number of reasons were reduced to sixteen. The criteria of reduction were

1. small variability in rank assigned.
2. reasonable differences in ranking, of the related specimens.
3. wide range of relevancy in the series.

These sixteen reasons were then arranged in a random order, and a group of sixty undergraduate students was instructed to rank them. On the basis of this ranking, eight samples were finally selected, according to the above three criteria; that is, samples were chosen (1) which exhibited small variability in their rankings, (2) which were fairly equally spaced in the sense that on adding up the totals formed by the ranks there was, for this particular group, approximately the same difference in totals. This does not mean, especially at either end of the scale, that the differences in relevancy are equal from passage to passage. To get such equal differences would be a great labor. We may say, however, that for the purposes of this investigation, the series is sufficiently graded to accomplish

its purpose. Owing to the loss of part of my material, I am unable to present the original data on which the rankings with the various topics were made. Fortunately the orders, which resulted from this work, were not lost. To verify the approximate accuracy of these orders, I have secured subsequently a rating by ten to thirteen competent judges, and their agreement with the previous, more complete rankings is sufficient to show that the original data are reliable enough for the limited objectives of this study.

RELATIVE VALUES IN READING

Reasons for saving

A. People who save are able to take advantage of unexpected business opportunities which demand ready money if they are to be seized.

B. A man is not considered successful unless he has a good deal of money in reserve; we must save money to give us standing among our neighbors.

C. There are always in every place the poor who are living at the point of starvation; if we save money we can help this struggling class.

D. Later in life when old age comes and it is no longer possible to work, savings provide a steady income and ensure independence.

E. With the saving of money it becomes advisable and usually necessary to have a bank book; the possession of a bank book is a source of genuine pride.

F. A man who has saved is largely independent of his fellow men. He no longer needs to co-operate in the earning of his living but can take up an independent attitude in which he need have no consideration for those around him. Even though men hate him he can buy their services.

G. One should save money during the year so that when the vacation comes, one may go to a fashionable summer resort and appear to be very wealthy.

H. Ill health may come at any time in a person's life; this possibility demands that we put by enough money to draw on in such a need.

I. It often happens, through no fault of one's own, that one loses one's position; it is necessary to have money to tide one over until one finds another opening.

J. All people are liable to sudden unexpected expenses; if there are no savings on which to fall back, it is very easy to run into debt.

K. To have an expensive funeral is a very fitting end of a life; without savings such a funeral is impossible.

L. One of the good reasons which prompt people to save is found in the desire to leave money and property to those who come after.

Relative Values in Reading

Reasons for reading good literature

A. Unless one has a wide acquaintance with the English tongue it is almost impossible to write accurate and concise telegrams; seeing that these messages are both urgent and expensive we have another argument for good reading.

B. Literature, by revealing to us the great achievements and longings of mankind, excites us to self activity, it furnishes our ideals and creates the energy with which they may be pursued.

C. Even if for no other reason the pleasure which comes from handling books, observing their various forms, their different textures, their multiform bindings, would compensate the reader for the time that he spent in wide reading.

D. A wide acquaintance with good books enables us to understand the literary references which are so common in the newspapers and weeklies. Since these journals contain the news of the world it would seem very desirable to read good literature.

E. The reading of good literature gives a mentally healthy attitude, makes life take on new colors, reveals romance in everyday things, thus contributing greatly to the satisfactions of life.

F. The habit of reading good literature is the mark of the educated man; whether one enjoys reading or not, it is valuable to read widely and thus imitate the habits of the educated for others will think we belong to this class.

G. Wide reading of the best literature gives us an insight into the great world outside ourselves, opens up wide fields of interests, and gives us a power to meet the problems of today.

H. A bad deed can often be made to appear reasonable and fair, if it is accompanied by well chosen words. Good literature provides the vocabulary and fosters the power with which to cover such deeds.

I. In the writing of letters, both of a business and a private nature, the advantages of a free and easy style are great; these advantages are likely to be derived from the constant reading of good books.

J. A mind acquainted with the thoughts of the master minds of literature is in an excellent position to make sound judgments with regard to the perplexities of its own time and age.

In Tables I, II, and III will be found the ratings, made by the subsequent judges, compared with the average rating, given by the larger group. This last named ranking is shown in the last column but one. The average deviation is shown in the last column. It

TABLE I

Value of high school education

Judge	Rankings by competent judges (check group)													Rating by larger group	A. D. of check group
Reason	1	2	3	4	5	6	7	8	9	10	11	12	13		
A	5	5	5	5	4	3	4	5	3	4	3	3	5	4	.8
B	8	8	8	7	7	8	6	8	8	8	8	8	8	8	.3
C	6	6	7	6	5	6	7	6	6	5	6	6	7	6	.4
D	3	3	2	3	3	2	3	3	4	3	4	4	4	3	.5
E	2	2	3	2	1	4	2	2	2	2	2	2	2	2	.3
F	7	7	6	8	8	7	8	7	7	7	7	7	6	7	.4
G	1	1	1	1	2	1	1	1	1	1	1	1	1	1	.1
H	4	4	4	4	6	5	5	4	5	6	5	5	3	5	.7
Value of ρ	.98	.98	.93	.95	.93	.93	.93	.98	.98	.98	.98	.98	.89		

TABLE II

Value of reading good literature

Judge	Rankings by competent judges (check group)													Ranking by larger group	A. D. of check group
	1	2	3	4	5	6	7	8	9	10	11	12	13		
A	7	8	7	9	7	9	9	7	8	7	7	7	8	7	.7
B	2	3	3	3	4	1	1	1	1	1	2	1	3	2	.9
C	10	9	10	7	8	7	7	9	7	8	8	9	7	9	1.2
D	5	5	5	6	6	6	5	6	6	5	5	6	5	6	.5
E	4	4	4	4	2	4	4	4	3	4	3	4	4	4	.3
F	8	7	8	8	9	8	8	8	9	9	9	8	9	8	.5
G	1	1	1	2	3	2	3	2	2	3	1	2	1	1	.8
H	9	10	9	10	10	10	10	10	10	10	10	10	10	10	.2
I	6	6	6	5	5	5	6	5	5	6	6	5	6	5	.5
J	3	2	2	1	1	3	2	3	4	2	4	3	2	3	.8
Value of ρ	.97	.95	.96	.92	.90	.94	.92	.98	.94	.94	.97	.98	.94		

TABLE III

Reasons for saving

Judge	Rankings by competent judges (check group)											Rating by larger group	A. D. of check group
	1	2	3	4	5	6	7	8	9	10	11		
A	4	3	5	4	5	5	3	5	5	5	5	5	.5
B	8	8	9	7	9	9	8	8	8	8	10	9	.7
C	6	4	6	8	7	4	5	6	6	7	7	6	.9
D	1	2	1	1	1	1	2	1	1	1	1	1	.2
E	9	12	8	9	6	7	11	12	10	9	9	8	1.8
F	10	10	10	10	10	10	10	9	12	10	8	10	.5
G	12	9	11	11	11	11	9	10	9	11	11	11	.7
H	2	1	2	2	2	2	1	2	2	3	2	2	.3
I	3	5	4	3	3	3	4	3	3	4	4	4	.6
J	5	6	3	5	4	4	7	4	4	2	3	3	1.4
K	11	11	12	12	12	12	12	11	11	12	12	12	.4
L	7	7	7	6	8	6	6	7	7	6	6	7	.5
Value of ρ	.95	.84	1.00	.93	.97	.97	.87	.92	.93	.98	.97		

will be seen that although the second group of judges does not by any means agree absolutely with the larger group, the discrepancy is not sufficient to affect the purposes for which the scales are used.[1]

Given these series and their approximate order of ranking by competent judges, they can obviously be used to test the sense of relative values or judgment of any other group. Owing to the unreliability of ranking of any one series, by a particular subject,[2] if any attempt is made to employ them for individual diagnosis, a variety of series must be used. In this study, however, the scales are used merely for group examination.

Method of Examination

The sheets, in the form already shown, were distributed to the group under examination, together with a report sheet, and a larger piece of paper for making notes. The pupils were told to read the samples over three or four times, making as careful notes as they cared

[1] The bottom line of the tables shows the value of the correlation by rank square difference methods of each judge with composite ranking.

[2] For pupils of Grade VIII the correlation between rankings of two topics is not more than .3.

to, with a view to ultimately arranging them in their order of relevancy. Numerous illustrations were used, to make the idea of ranking obvious. At the close of the explanations, the author, who conducted all the tests, usually asked three or four pupils, selected at random, to explain just exactly what they had to do. It will be noticed that each reason has a key-letter attached to it. The pupils represented each sample in their ranking by the key-letter. The letters were arranged therefore in a vertical column, the pupils writing "best" opposite the top one, and "worst" after the bottom one. Usually, from fifteen to twenty-five minutes was necessary. No pupil was hurried. In very few cases was there evidence of pupils making careless or indifferent judgments. Rarely before the end of fifteen minutes was any pupil ready to hand in his order as final.

Another fact, interesting to note, is that even where a pupil's ranking of a sample deviated markedly from the probable order, in nearly all cases he had a reason, however inadequate, for his decision. Those who witnessed the experiment in progress agreed that the test was performed under the best conditions to admit of a pupil showing what sense of relative values with regard to these particular topics he possessed.

The following factors insured this:

1. the reasons were explicitly stated and did not have to be "thought up" by the pupil.
2. a much greater time was allowed for the decision than is allowed ordinarily in school for judgments of this kind.
3. there was no call for writing or for expression of ideas, which often complicates the ordinary process of judgment.
4. the topics were more within the experience of the pupils than many discussed in literature, history, civics, etc.

The general argument is that if, under these conditions, in many cases poor judgment is shown, it is easy to infer the quality of judgment that may be expected in reference to the complex factors of a distant period in history, etc., etc., or in affairs which are as remote from the pupils' experiences as are, necessarily, many of the topics taught in school.

The three tests were given to various groups from Grades VI, VII, and VIII. The pupils were chosen alphabetically to prevent selective influences. The results of applying the first test (Reasons for Going to High School) to a group of approximately thirty-two pupils in Grades

VI, VII, and VIII are shown in the tables IV and V. Horizontally, the various reasons have been arranged in the order, the derivation of which has been previously explained, which is at least a close approximation to an omniscient rating. Vertically are shown the rankings given, by the group, to each reason. Since this particular Grade VI and Grade VII, as will be shown later by reference to correlation data, have approximately the same power of arranging the reasons in true order, I have compounded the results Table IV for these two groups, comparing these with the ratings given by Grade VIII, Table V.

TABLE IV

Value of going to high school
Grades VI and VII combined

Rankings	Reasons arranged in approximately correct order							
	G	E	D	A	H	C	F	B
1	25	11	3	12	4	3	4	2
2	14	22	12	6	2	3	1	4
3	13	9	14	11	4	5	4	4
4	3	11	12	10	8	10	3	7
5	3	8	7	9	13	11	7	6
6	1	1	6	7	13	16	5	15
7	4	1	5	6	13	13	15	7
8	1	1	5	3	7	3	25	19

TABLE V
Grade VIII

Rankings	G	E	D	A	H	C	F	B
1	22	2	7	1				
2	5	8	10	6	1	2		
3	3	12	7	4	3	3		
4	2	8	2	13	3	3	1	
5	..	1	1	7	14	4	4	1
6	..	1	5	1	4	13	1	7
7	..	..	..	..	7	6	11	8
8	..	..	..	..	..	1	15	16

TABLE VI

Rankings by Grade VI and VII combined

Reasons for saving

Rankings	Reasons arranged in approximately correct order											
	D	H	J	I	A	C	L	E	B	F	G	K
1	18	5	1	3	7	19	1	1	4	3	1	
2	14	11	7	1	5	13	1	4	2	3	..	2
3	7	15	8	7	5	8	1	4	2	5	..	1
4	6	10	5	18	8	4	2	1	1	5	2	1
5	7	8	13	9	6	2	2	4	3	6	1	2
6	5	1	7	10	7	4	6	7	3	9	3	1
7	3	..	11	3	8	5	6	10	5	3	4	5
8	2	5	3	2	2	4	15	5	9	8	3	5
9	..	4	4	4	..	1	5	8	13	5	9	10
10	1	2	1	2	4	1	7	11	7	6	14	7
11	..	2	1	2	7	1	9	7	9	6	9	10
12	..	..	2	2	4	1	8	1	5	4	17	19

TABLE VII

Rankings by Grade VIII

Reasons for saving

	Reasons arranged in approximately correct order											
	D	H	J	I	A	C	L	E	B	F	G	K
1	10	6	..	2	1	6	..	2	..	3		
2	5	10	3	3	2	3	..	1	..	3		
3	3	6	8	3	1	5	1	..	1	2		
4	4	4	2	8	4	4	..	1	..	3		
5	3	1	5	5	8	1	..	4	1	..	1	1
6	1	..	6	4	6	6	3	1	2	..	1	
7	3	2	2	1	3	3	3	6	3	2	..	2
8	..	1	..	2	..	1	7	2	4	8	4	1
9	1	..	..	..	1	..	1	6	12	2	1	6
10	..	..	2	..	1	..	8	4	3	4	3	5
11	..	..	2	1	2	..	6	1	2	2	4	10
12	..	..	..	1	1	1	1	2	2	1	16	5

It will be seen, from what constitutes a scatter diagram, the extreme variability of Grades VI and VII, the results of which have been combined. Any reason, good or bad, was placed, by some member of the group, in any possible ranking. (See reasons D, H, C, B.) Seeing that this topic gave the highest correlation, for Grades VI and VII, of all the topics, the only other diagrams Table VI and VII which will be shown are those for the series entitled "Reasons for Savings." The Grade VIII diagrams for both still reveal considerable variability of judgment, but the amount of variability is much reduced.

The first coefficient of correlation (p) has been calculated for each pupil for each topic by the square difference rank method, the squared difference method being selected because of the small penalty attached to a wrong placement of one position and the correspondingly large penalty inflicted for greater displacements. All the values have been kept in terms of (p). These are shown in Table VIII, for the three topics.

TABLE VIII

Table showing distribution of correlations for each grade

Value of	Value of high school			Reading of good literature			Saving		
	VI	VII	VIII	VI	VII	VIII	VI	VII	VIII
.95	4	1	10	....	1	3	....	1	3
.85	3	4	6	1	....	6	3	6	7
.75	4	4	8	....	....	5	3	8	9
.65	4	7	5	2	....	1	3	5	4
.55	3	3	2	2	4	1	10	2	4
.45	2	2	.....	1	2	3	....	3	1
.35	2	3	1	3	5	1	3	1	
.25	5	1	.....	5	2	2	3	1	1
.15	....	2	.....	4	6	5	3		
+.05	3	1	.....	6	5	2	1	3	1
−.05	....	....	.....	1	2	1	....	2	
−.15	1	2	.....	2	2	....	1	....	2
−.25	....	2	.....	2	1	....	1		
−.35	....	....	.....	....	1	2			
−.45	....	....	.....	2					
−.55									
−.65				1					
Av.	.53	.48	.74	.14	.21	.48	.46	.57	.63

An examination of Table (VIII) reveals the extraordinarily small power of arranging samples, possessed by a considerable number of the pupils. Thus out of a total number of one hundred and ninety-nine ratings made by Grade VI and VII pupils, forty-four, or twenty-two per cent were so poor that they could have been equalled or exceeded by random drawing. Even with Grade VIII pupils, out of ninety-eight ratings made, eight per cent were so poor as to be capable of production by blind drawing.

In the following average Table IX I have combined the results of two further topics, taken from the unpublished work of one of my students, Mr. A. W. Brown. His data were furnished by one hundred and twenty-two pupils, approximately equally distributed over the three grades, the groups being different from those used on the first three topics.

TABLE IX

Topic	Average value of correlation for grades			
	VI	VII	VIII	Graduate students
High school	.53	.48	.73	.96
Good literature	.14	.21	.48	.95
Savings	.46	.57	.63	.94
Sports	.31	.25	.51	.92
School until 14 yrs	.31	.32	.52	.91
Averages	.35	.37	.58	.94

Interpretation of Results

While little reliability can be attached to any single figure, yet certain conclusions based on large averages may be drawn without undue forcing. We may say that for such passages as have been chosen:

1. Grade VI and Grade VII, on an average, fail to exhibit an ability which enables them to rank reasons with a sufficient degree of accuracy to yield an average correlation of .36.

2. Grade VIII is distinctly better than Grades VI or VII, though even in Grade VIII the correlation is only .58.

3. What may be accepted as a standard correlation, at least as good a correlation as can be obtained from any group, can be taken as .94, the average afforded by a small group of graduate students.

4. Whether the extremely rapid rise between Grade VII and VIII will be substantiated by further experimentation is at least open to doubt. If the result is taken at its face value, it can easily be explained on the assumption that it is not until Grade VIII is reached that the pupils, as a group, have the necessary contributing factors to form even a fairly reliable judgment of this degree of complexity. Among these contributing factors are

1. the necessary background of experience,
2. the easy understanding of what is read,
3. the habit of suspending judgment,
4. the habit of taking pains, if such generalized habits may be supposed to exist.

The general conclusions of the paper are of course absolutely dependent upon the manner in which the reader interprets what is the success attending a group, for which the average correlation, under the conditions of the experiment, is .36. Certainly an examination of the sample scatter diagrams should make evident how difficult it must be to obtain anything approaching sound group judgment, involving complex subject matter, from a class of Grade VI or Grade VII pupils. The teacher in these grades, finding the judgments so erratic, and having a somewhat heavy curriculm, resorts to the natural alternative, namely, dogmatic statements.

If the reader believes that this low correlation is due largely to lack of training, he will merely quote this study as further evidence of the evil results of dogmatic method of teaching. Certainly under present-day school conditions, children are given little opportunity to have their judgments checked up and talked over by those in authority. In many cases they are not even allowed to have their own opinions.

In contradistinction to this interpretation, if the reader inclines to the belief that judgments of this type depend upon a hierarchy of habits, and a breadth of experience, which for obvious reasons are somewhat late in appearance, then there is perhaps in those subjects involving complex factors some justification for the present dogmatic methods of teaching in the grades. At the present moment, the author has no quantitative evidence to offer, which would help to decide this crucial question.

My thanks are due to Mr. C. L. Kirschner of the New Haven High School and Mr. W. H. Martin of the Scranton School for the facilities afforded me in their schools.

FURTHER DATA ON THE BELL CHEMISTRY TEST

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A recent article by Professor Thomas H. Briggs[1] of Columbia, suggesting that the original standards set by the author of the Bell Chemistry Test[2] may be too low, has stimulated the writer of this paper to offer the results of his use of the Bell Test in support of the position of Doctor Briggs. The basis of this report is in records made by two groups of pupils; one in the Biddeford (Maine) High School and one at Worcester Academy. Group I was a class of twenty-two high school Juniors, fourteen boys and eight girls, who were tested near the completion of nine months of study of chemistry. Group II

TABLE I

Scores in Bell chemistry test

Score	Number of pupils	
	Group I Nine months of training under a teacher with one year's experience	Group II After six months of study
below 50	3	1
50–54	0	3
55–59	4	3
60–64	3	1
65–69	2	4
70–74	3	0
75–79	5	6
80–84	1	4
85–89	0	1
90 and above	1	2
Total.....	22	25
Median.....	68	75
Average.....	65.7	70.1

[1] *Journal of Educational Psychology*, 11: 224–8.

[2] *Id.* 9: 199–209. *School of Science and Mathematics*, 18: 425–32.

was a group of twenty-five boys, mostly Seniors, tested after six months of training. The first group was taught by a man with one year's experience; the second, by the writer. The distribution of scores is shown in Table I.

These two sets of papers were marked before the publication of the acceptable answers,[1] yet there was so close an agreement between the set used and the published set that the resulting scores are not seriously affected by the minor differences. The differences that existed were of such a nature as to reduce slightly the scores of Groups I and II below what they would have been had the published answers been available. These two groups were made up of unselected pupils from two types of New England secondary schools, subjected to the Bell Test without warning. Therefore, the results may be deserving of consideration in arriving at a final standard.

For purposes of convenient comparison, these results are shown with those of Bell and Briggs in Table II.

TABLE II

Results of Bell chemistry test

Group	Scores	
	Median	Average
Three hundred thirty-seven pupils in fourteen Texas High Schools[2]	.....	59
Twenty-seven pupils in Reading (Pa.) Boys' High School[1]	57.25	57.96
Eleven pupils in Horace Mann School for Boys[1]	82.5	79.09
Twenty-two pupils in Biddeford (Me.) High School	68	65.7
Twenty-five boys in Worcester (Mass.) Academy	75	70.1

The relative difficulty of the twenty-five questions may be judged from Table III.

Table III is read as follows: The easiest question (*i.e.*, the one receiving a correct answer from the largest per cent of pupils) was number one (What chemicals are liberated in the electrolysis of water?) for the pupils of fourteen Texas high schools after eight months of training; number fourteen (Name the two most abundant elements in the atmosphere) for the Biddeford High School Juniors after nine months of study; and number one for the Worcester Academy Seniors who had studied Chemistry six months. The next to the easiest

TABLE III

Relative difficulty of questions in Bell chemistry test as judged from the per cent of students giving correct answers.

Position of the question	Number of the question		
	Fourteen Texas schools after 8 months of study[3]	Group I. Biddeford H. S. Juniors after 9 months study	Group II. Worcester Academy boys after 6 months study
1 easiest	1	14	1
2	2	2	4
3	24		
			5–23
4		4–19–24	
	5–19		
5			24
6	14	1	16
7	10	11	
			14–22
8	23	8	
9	13		
		6–22	8–19
10	16		
11	22	9	
			6–13
12	6		
		5–7	
13		....	3
	3–18		
14		10	
			10–25
15	7	3	
16		25	12
	4–8		
17			17–20
18	11	18–20–23	
19			11
	9–12		
20		16	7
21	17	21	2
22	20	15	9
23	25	13	21
24	21	17	15
25 most difficult	15	12	18

3. From tables I and III, Journal of Educational Psychology, 9 : 199–209.

question was number two (What gas is given off by the action of yeast in bread dough?) for the two high school groups and number four (Express in cubic centimeters one liter) for the Worcester Academy boys, etc.

In this table it will be noted that of the easiest seven questions for the Texas group, five were among the easiest seven for Group I;

and four, for Group II. Of the most difficult seven questions for the Texas group five are found among the most difficult seven for Group I and only three for Group II. The correlations in these three cases, calculated according to the Pearson method are found in Table IV.

TABLE IV

Grade-position correlations for the twenty-five questions of the Bell chemistry test.

Groups correlated	r
Texas group—Group I	.63
Texas group—Group II	.61
Group I—Group II	.42
Average	.55

TRAINING IN PERCEPTION AS A MEANS OF ACCELERATING THE SILENT READING RATE[1]

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The core of the reading complex is the process of perception. The movement of the eyes from pause to pause, their convergence and divergence in fixation, the numerous and varied play of the neural-muscular mechanism involved in the ocular adjustment to the printed symbols, are all subsidiary to the main process of perception. The latter constitutes the actual seeing or visualization of the printed words. The results of numerous investigations, as stated in the earlier chapters, have shown that the overwhelming bulk of the reading time, in fact from $^{12}/_{13}$ to $^{23}/_{24}$, is consumed by the fixation pauses. The total reading time, therefore, may be said to be practically the number of the pauses multiplied by their average duration. But the number of pauses per line is dependent upon the size of the perceptual span—the wider the span the fewer the pauses, and *vice versa*. Hence a type of training that is to effect any appreciable economy in the reading time must in some way or other influence the perceptual process that occurs in the fixation pause. The improvement may be secured either by widening the visual span, causing fewer fixations, or by accelerating the perceptual process thus lessening the duration of the fixation pauses, or by a combination of both these results.

Peripheral Vision

Upon the fixation pause, during which all vision or perception occurs, has been focused the attention of many investigators. The perception that occurs therein is of two kinds, foveal and peripheral. The area that can be grasped by foveal vision in any one fixation is relatively small. Only about five letters (1)[2] will be "unequivocally clear" when the eyes are held quite stationary. The adjoining letters will not be so sharply defined, but will shade off gradually into a hazy outline growing fainter and fainter as they recede from the foveal area. These letters are grasped only by peripheral vision. The area of

[1] A chapter from the book, "Silent Reading," which has just been published by The Macmillan Co.

[2] Numbers in parentheses refer to corresponding numbers in the end of this article.

peripheral vision is consequently much larger than that of clear vision. The number and duration of pauses per line and the speed of reading in general are thus seen to be conditioned to a considerable degree by the effective utilization of extra-foveal vision. The importance of this phase of the reading-complex seems to have been rather generally overlooked. Practically no conscious attempt is made in the present teaching of reading in the schools to develop peripheral vision or to enlarge its area. Reading which is wholly or chiefly dependent upon foveal vision will be slow and halting, marred by too frequent pauses which inhibit the development of a regular rhythmical swing of the eyes in traversing the printed line.

Dodge (1) who has analyzed the functioning of the various elements in the reading complex with marked acuteness, thus describes the work of extra-foveal vision:

"Sometimes the peripheral vision of words when they are indistinctly seen in the hazy part of a line, is sufficient for reading. It is always useful furnishing an important premonition of coming words and phrases, as well as a consciousness of the relation of the immediately fixated symbols to the larger groups of phrase and sentence. Without this premonition of coming words and the outlines of larger groups, the process of reading would be slow and difficult."

"In normal reading . . . there is abundant evidence that the word forms, indistinctly seen in peripheral vision begin the reading process well in advance of direct fixation and the consequent clearing up of the letters.

It is this premonition of coming words and phrases, sentence breaks, and paragraphs, that determines the position of future fixations, and reduces the duration of individual fixations sometimes to pauses one-quarter the normal perception time. They are often less than the simple reaction of the eye."

Not only is peripheral vision effective in decreasing the number and duration of the fixation pauses per line and consequently accelerating the rate, but it is also instrumental in fostering and stimulating meaning premonitions, thereby improving comprehension as well. Hand in hand with reaching out of perception beyond the immediate field of clear vision seems to go the reaching ahead of the assimilative factor beyond the meaning grasped in direct fixation to those dimly felt in the extra-foveal area. Meaning premonitions made more numerous and more vigorous by the functioning of a wide peripheral vision, play an important rôle in the rapid interpretation of the printed

page. Just as extra-foveal vision frequently suffices for the reading of a word without the agency of direct fixation, so meaning premonitions not infrequently carry the reader over many a word without the immediate apprehension of the word in direct fixation. This is evidenced by the fact that a person in reading a selection aloud in which the meaning premonitions stream thick and fast in his consciousness will unwittingly substitute a synonym for the word actually occurring in the passage.

Concerning the importance of these meaning premonitions, Dodge (1) says: "Adequate premonitions are as conspicuously lacking in the stumbling reading of childhood as in our reading of a foreign language. Their development is a most important part of the training in rapid reading. The very rapid reader who makes two or three steps in a line can see no more distinctly than the plodder with ten. *His main advantage is in the way he grasps what he sees only indistinctly in the extra-fixational vision.*" (Italics are inserted.)

The type of Training which will be outlined in this article has aimed to develop the more generous utilization of peripheral vision, and of its mental correlate—meaning premonitions. The direction to the pupils in the exposure exercises, requesting them to read the sentence "as a whole" allowing time sufficient for but a single fixation was calculated to call the peripheral vision into play, while the suggestion to occasionally look up and tell "how much they saw ahead" and how much of the remaining meaning of the sentence they could give, was designed to develop meaning premonitions along with the extra-foveal vision.

Foveal Vision

However important a factor peripheral vision may be in developing rapid, effective reading, direct or foveal vision still constitutes the core of the perceptual process—perception *per se*. In the field of clear vision it is not a matter of conjectural interpretation or inferences from previously perceived premises, but a matter of direct fixation and immediate apprehension. The functioning of direct fixation in connection with extra-foveal vision, Dodge (1) thus describes: "In adult reading the moment of actual fixation seems to be an incident somewhere in the middle of the reading process. Coming between the premonition and the after echo, its effect is to correct, confirm, and to intensify the premonition. Psychologically, its function is selective and definitive. It emphasizes the excitation of suitable residua and

inhibits the misfits. The pedagogical importance of word forms is clear. It is possible that special training in peripheral vision would be worth while, but it is equally evident that no training is adequate which does not provide for the corrective cooperation of direct fixation.

The Type of Training to be outlined in this article, aims definitely at the enlarging of the perceptual span functioning in reading. The work in exposure exercises attacks this problem directly. It endeavors to widen the span of attention so as to grasp, three, four, five, six, and even more words if possible in a single fixation. C. T. Gray (2) showed that a marked increase in the visual span resulted in the case of two fourth-grade subjects after training in perception by means of tachistoscopic exposures. In the case of the two sixth-grade subjects, however, similar short exposure exercises did not seem to effect any appreciable widening of the perceptual span *as determined by the number of words grasped in a tachistoscopic exposure.* However, an examination of the data afforded by the photographic record of the eye movements in the reading of one of the two subjects, B.R., taken before and after the training in perception yields a rather striking result. The following is a statement of the record as reported by Gray (2).

TABLE I

Eye-movement record of B. R. before and after practice

	Average No. of pauses	Average length of pauses	Average No. of regressive movements
Before practice.....	15.5	15.4	4.5
After practice.....	6.1	12.6	1.2
After 3 months interval.....	8.4	....	1.2

An examination of these records clearly demonstrates a striking enlargement of the perceptual span *which functions in actual reading.* This is evidenced by the reduction in the average number of pauses per line from 15.5 in the first reading to 6.1 in the reading after the practice in perception. This indicates that the size of the perceptual span was more than doubled since its width bears an *inverse* proportion to the number of fixation-pauses per line. Even the average duration of the perceptual process in the fixation-pauses was decreased from 15.4 to 12.6 showing improvement in this phase of the process also. A notable decrease in the average number of regressive movements per line is

likewise noticeable. B. R.'s rate of reading as determined by careful tests had increased from 1.0 word per second before the practice to 5.0 words per second after the training—an improvement of 400 per cent.

Consequently while B. R.'s span of attention showed no notable increase in grasping numbers of words exposed by a tachistoscope, it showed a striking enlargement in reading an actual context. In alluding to this point in Chapter III, the writer termed the latter the *relative span of attention*, the span which functions in reading a context material, in contradistinction to the *absolute* span which functions in tachistoscopic exposure work. Exercises of this latter character have shown that the perceptual span which they call into play, grasping, as it does, five and six words in a single fixation, is seldom fully utilized in ordinary reading where the span rarely exceeds two or three words. Consequently, while the absolute span of perception may show no increase as a result of training in perception, the relative span which functions in ordinary reading may reveal a striking increase as in the present instance. In other words, the perceptual span is *utilized more effectively* in reading. The point made here is that this is true not only of fourth-grade subjects, but also of older subjects as B. R.'s case well illustrates. The eye-movement records of B. R. certainly lend no support to the tentative conclusion of Gray that training in perception, if it is to produce results, should come before the fourth-grade. For, the perceptual span as it functions, not in the grasping of isolated words or phrases, but as it is used in the reading of connected material is the important factor. That this latter is susceptible to improvement has been clearly shown by the record of Gray's subject, B. R.

Relation of Speed of Reading to Types of Imagery

What is the effect of the different types of mental imagery upon the rate of reading? In other words, is the reading rate largely conditioned by the mode of imaging? If so, what types are conducive to rapidity and what ones tend to retard? These are some of the interesting questions which have been touched upon in recent studies in the psychology of reading.

To the above queries W. A. Schmidt (3) gives no uncertain answer:

"Individuals of this (visual) type" says he, "are by nature rapid readers, other conditions being equal. Their speed is not due to scanning, however, for they have no occasion to resort to this, since there is almost no limit to the rate of visualization. The motor type, on the other hand, tends to represent the slowest readers, the dependence

upon the physiological mechanism being in this case quite marked. The auditory type ranks between the two, the hearing of the words being in this case often quite vestigal. This type appears to be much more common than either of the other two types. Most of the evidence which the writer has been able to gather through interviews with a large number of individuals seems to support the conclusion that the auditory-motor type of reader can compete with the visual only when he is able to resort to scanning. There can be little doubt that rapid readers fall almost exclusively into these two classes—those on the one hand who are good visualizers and those on the other hand who have acquired the ability to gather meaning from the printed page without definitely reading all the words and sentences."

The above conclusion of Schmidt's appears to the writer to possess a certain amouut of plausibility. It seems at least *a priori* logical to assume that reading which involves merely, or at least chiefly, visualization, requires less functioning of the physiological mechanism than the auditory or motor type with their more or less elaborate movement of the musculature of articulation. Involving a less elaborate functioning, visualization would seem to be a more direct aud more rapid mode of reading. Schmidt appears to go rather far, however, in maintaining that "good readers fall almost exclusively into two classes"—good visualizers and those able to scan; that the auditory or motor readers can compete with visualizers only when they resort to scanning.

In the first place, the data which throw any light upon the influence of the various types of imagery upon the reading rate are exceedingly meagre. The scanty evidence that is available, however, does not seem to warrant so positive a statement as to the conditioning, determining influence of the mode of imaging upon reading rate. There are numerous instances in the literature of very rapid readers who are decidedly "auditares" and "motaires" but who can compete very successfully with the visuals. Moreover, it is to be remembered that the audition may be of the faint, vestigial, psychical character involving according to the introspection of some psychologists, no movement whatsoever of the musculature of articulation. In the writer's judgment it is in the latter factor—the elaborate functioning of the physiological mechanism of vocalization—that the retarding influence is largely to be located. If the latter be eliminated a high rate of speed may be reached regardless of the tpye of imagery, as the results of the present investigation indicate.

"Most of the evidence which the writer has been able to gather through interviews" is mentioned by Schmidt as the data[1] from which he generalizes concerning the conditioning influence of the various types of imagery upon the reading rate. A grave difficulty which confronted the writer in his endeavor to secure data on this point by questioning readers as to their mode of imaging and their reading rate, was their inability in the overwhelming majority of cases to determine with anything approaching certainty what is their dominant type of imagery. Nor is that strange. For, practically all the recent investigations (4–9) of imagery types have shown that as a general rule individuals employ not a single constant type but many types of imagery. Netschajeff (10) has conclusively demonstrated the existence of such combinations of imagery types for example, as the visual-motor, the auditory-motor, the auditory-visual motor, etc. Indeed, even in a single type of mental work, individuals are found using now one, now another mode of imaging. There is a confusing complexity of modes of imaging in a single individual.

In view of this fact it is not surprising that an individual when interviewed can scarcely state off-hand what is his precise type of imagery. Even when subjected to psychological tests in the laboratory, the dominant type of imagery is not always established with certainty. Indeed there is no single, psychological test, that can be relied upon to discover with certainty the dominant mode of imaging in the case of a "mixed" type. It is in the latter case, moreover, that most individuals are found to belong. Meumann (11) epitomizes the result of his own extensive investigations and those of other investigators when he states: "Investigation has shown, however, the the great majority of people belong not to pure, but to mixed or balanced ideational types. In there cases, we have a compromise

[1] After the above had been written, the writer received a communication from Dr. Schmidt, in which the latter mentions Quantz's experiment as corroborative of his generalization. As the writer had already analyzed the results of Quantz's experiment in this article, it is felt that all of the essential data upon which Dr. Schmidt's conclusion rests, have been considered. Dr. Schmidt also states that the adults whom he interviewed "were, for the most part, individuals who had studied psychology rather extensively. In consequence they were, as a rule, able to attempt (whether they succeeded is quite another question) to classify themselves as auditory, motor, or visual in type." In the writer's judgment, the attempt to classify oneself in regard to imagery type, without using any psychological test, is rather precarious. Dr. Schmidt has the gratitude of the writer for his additional information.

between ideational type and sense-modality." Illustrating the complexity of modes of imaging in a single individual, he says: "For instance, the concrete visual type of ideation may co-exist in any individual with verbal ideation of another source,—with vocal-motor or with verbal auditory imagery."

Consequently the question might well be raised as to the accuracy and the general value to be attached to information derived from interviews upon a question that is notoriously difficult to answer, even when fortified with the results of a psychological test, let alone when answered off-hand without such a basis for a reply.

The only express attempt, to the writer's knowledge, to attack the problem of the influence of imagery types upon reading rate was the experiment of Quantz (12) at Wisconsin. Quantz sought to determine the relative influence of the visual and the aural bias upon the reading rate in three ways: "(1) by testing the visual and auditory span; that is, the limit of power to repeat correctly words read or heard once; (2) by detection of differences between two variant readings of the same passage; (3) by the ability to reproduce the thoughts of two selections, one of which was read to the subject, the other read silently by him, *at the same time.*"

Whether any of these three tests actually determined the dominant type, or even the relative strength of the visual and auditory imagery in the individual, is very doubtful. Underlying the three methods employed by Quantz is the assumption that the capacity to grasp and remember or reproduce words presented orally, or visually constitutes an index of the relative strength of the auditory or visual type of imagery. That words presented orally and reproduced in the same manner do not necessarily tap solely the auditory type of imagery is evident from the fact that there is always the possibility of transforming the auditory impression into another more favored type of imagery. The same is true of the possibility of transforming the visual impression into an auditory image. The existence of such a substitute mode of imaging, a "surrogate," or sort of vicarious functioning of imagery types, which has been experimentally demonstrated by Meumann serves to render the fundamental assumption underlying Quantz's three tests very doubtful and the conclusions based upon such tests, of similar questionable validity.

Indeed Meumann (11) cities as an illustration of a process wherein substitute imagery may be employed, practically the same task as

Quantz's test of the span of prehension—"the limit of power to repeat correctly words read or heard once." "Let us take," says Meumann, "the case of an individual who has read a list of words or to whom such a list has been dictated, with a view to having them reproduced immediately in vocal form. The mixed type is always able to adapt itself to this task. . . In recalling auditory words immediately after hearing them, the visualizer may employ auditory images chiefly, but may make a secondary use of the visual imagery into which he has transformed the auditory material; but in recalling a conversation with a friend after a long interval,. . . he has recourse chiefly to visual images of expressions employed by his friend during the conversation. The individual who belongs to a pure type, on the other hand, endeavors in immediate retention to transform into his own favored imagery the sensory impressions which he receives."

The results obtained from the three tests applied by Quantz are by no means uniform. The evidence from the first test (span of prehension) Quantz construes to indicate "a gradual increase in the rate of reading as the subject moves away from the auditory type and toward the visual." The results of the second test (detection of differences) are just the reverse, showing that the auditory type is decidedly more conductive to rapidity in reading than the visual type; while the third test (comparison by simultaneous processes) seems to show a correlation between eye-mindedness and rapid reading. The conflicting character of the results obtained tends strongly to corroborate the writer's conclusion that not one of Quantz's three tests are really capable of determining whether the subject was dominantly of the visual or of the auditory type. Not having determined that first essential fact for a comparison of the relative advantage of the visual or auditory bias upon the reading rate, conclusions based upon correlations of reading rate with prehension span or similar exercises are quite lacking in validity. But even if it were assumed that the imagery types were established with precision, a conclusion as to the decided advantage of the visual over the auditory would scarcely be warranted in view of the conflicting character of the results obtained.

Thus the results—meagre and conflicting as they are—of the only direct experimental investigation of this problem would hardly seem to support so positive a conclusion as Schmidt's that "the auditory-motor type of reader can compete with the visual only when he is able to resort to scanning."

Meumann does not treat specifically of the effect of the imagery types upon rate of reading, but he does discuss their influence upon rate of associative learning. In this connection, he states that "the auditory-motor individual always seems to possess a less reliable, but a *more rapid* memory " than the individual of the visual type. The auditory-motor type seems to function more rapidly in associative learning.

To the question then, is the visual or the auditory bias more conductive to rapidity in reading, no positive definite answer, in the writer's judgement, can as yet be given. The paucity of experimental evidence on this point is such as to render any conclusion but tentative and highly conjectural. The conclusion of Schmidt's ranking the visual type as the most advantageous, the motor type the least, and the auditory as intermediate, while theoretically very plausible, is, as yet, without sufficient experimental corroboration. But the meagre evidence that does exist warrants no such fatalistic attitude as Schmidt's concerning the all-powerful, conditioning influence of the imagery type upon reading rate. Rapid readers have been found among all types of imagery. In the present study the vast increase in speed reported of all the experimental pupils in certain grades, —in which there were beyond doubt different types of imagery—indicates that marked improvement in rate may be secured regardless of the pupil's mode of imaging.

Training in Perception

The third type of training has been based directly upon the findings of the psychological laboratory as to the functioning of the eyes during reading, showing the crucial importance of developing and widening the perceptual span, or at least of making more effective use of it in reading, of decreasing the duration of the fixation pauses, and cultivating a regular rhythmical swing of the eyes in the interfixation movements. The method was worked out carefully in its entirety. It was found, however, that none of the present types of tachistoscope could be used satisfactorily for groups of pupils. In class exercises the word or phrase exposed should be legible equally, (or approximately so) to every pupil. An apparatus which would expose cards containing words and phrases of varying length suitable to a whole class, for intervals ranging from about $\frac{1}{12}$ of a second to two seconds, and which would, moreover, be easily manipulated by the teacher

was found necessary if the work was to be done with the scientific accuracy necessary for the purposes of this experiment.

Such an instrument could not be devised in the time at the writer's disposal before the launching of the experiment on the scheduled date. C. H. Stoelting of Chicago with whom the plans were carefully discussed, has given the writer the assurance that an instrument of this type suitable for class-room purposes can be devised. Superintendent Taylor of Oregon has also worked out plans for its construction. The proper instrument may be available shortly. Though this type of training was not actually applied in the present investigation because of the lack of proper technical apparatus, it is thought that the presentation of an outline of the method may be worth while. This would seem to be so in view of the probable appearance of the necessary mechanical device in the near future and because there is considerable evidence which points to a method of this kind as capable of greatly accelerating the reading rate. It is the hope of the promoters of this experiment to submit this type of training to an actual test when the necessary mechanical facilities are at hand.

Training in Rapidity of Reading by Means of Perception Cards

References: Types of Reading Ability as Exhibited Through Tests and Laboratory Experiments, C. T. Gray, Supplementary Monographs, Vol. I, No. 5, University of Chicago Press, pages 149ff and 157ff.

The purpose of this investigation is to determine the extent to which speed in silent reading can be increased by training pupils in rapid reading through the use of perception cards. The practical value of a type of training which will accelerate the rate of silent reading is obvious. Your cooperation in this study will aid in definitely ascertaining means of accomplishing this end. The results of this investigation will be sent to every teacher participating in the work.

The cards used should be four inches wide and of varying lengths to contain words, phrases, or sentences.

The use of these cards is analogous to that of the exposure of material in laboratory work by means of an exposure apparatus or tachistoscope. In both cases, the subject is required to perceive the material exposed in as short a time as possible. There is experimental

evidence tending to show that the amount of verbal material which a person can perceive in a given time can be increased—in other words, that perception may be improved. Probably it is not true that perception as a native endowment may be improved, but the method of using the native endowment—*i.e.* the performance—is susceptible of extensive improvement.

The rate at which children can perceive words, phrases, and sentences has a rather obvious bearing on their speed of reading. Reading consists of a successive series of perceptions. The eye does not move regularly along the printed line but jumps from one point to another, pausing at each point. It is during the pause that perception takes place. In a very real sense, therefore, the printed line consists of a series of flashes or exposures.

To improve the rate of reading, we need to reduce the number of exposures per line by increasing the amount of material presented at each exposure and to shorten the length of each exposure. This suggests that we may directly attack the problem of increasing the speed of reading (*a*) by training the pupil to "see more at a glance," and (*b*) by training him to see the material more quickly.

Obviously we cannot control either the amount seen at a glance or the time of the exposure by using the printed page. If, however, we can present, by means of perception cards, portions of the text in the form of words, phrases, and sentences, we may gradually lengthen the amount of material on the cards as the pupil's ability to perceive it increases, and we may also reduce the time during which it is placed in view.

This is the fundamental idea in the method we are now proposing.

The reading period should be 30 minutes long. Half the period should be devoted to the presentation of material by means of the perception cards. The remainder of the period should be devoted to reading from the book in which, as far as possible, the same words, phrases and sentences are met.

During the first half of the period the attempt should always be to make the period of exposure of the cards as short as possible. Day by day the length of the material should be increased. In fact, either one of two methods may be used and both should be used during the course of the experiment: (*a*) the time of exposure may be kept constant and the length of the material may be increased; (*b*) the length of the material may be kept constant and the time decreased.

In order to obviate as far as possible any interference with the

perceptive processes due to the presence of unfamiliar words, the teacher should drill on single words which she has reason to believe are unknown to a number of the children. These words may be placed on the board or presented in the usual manner.

It is desirable that the material be printed on the perception cards rather than written. For this purpose a stamping outfit should be provided. It is recognized also that a great deal of work will be involved in preparation for the class period. The promoters of the experiment are willing to cooperate with the teachers in securing help for this work.

The second part of the period should be devoted to a conscious attempt on the part of the teacher to secure a transfer of the perception processes from the cards to the printed page. When a phrase or sentence is encountered, children should be told that the phrase or sentence is to be "seen altogether." Such directions as "do not look at every word," "see it as a whole," read it altogether" and the like, may serve to carry over from the work with the cards to the work in the book something of the same attitude.

This method should continue for two months. An accurate record of the progress of the pupils should be kept so that the increase in perceptual span and in rapidity of perception may be noted. A simple form will be provided for this purpose. The teacher is also requested to keep a diary in which she will daily record notes and observations concerning the progress of the experiment.

The teacher should select easy reading material for use during this experiment in order that the difficulty due to unfamiliar words may be reduced. In all the reading other than that done in the half hours set aside for the experiment, the teacher should seek by admonition, encouragement and example to inculcate the idea of increasing the span of perception—*e.g.* reading by phrases—and to decrease the time required to "look at" a group of words. An interesting exercise may be devised in which pupils may be requested to glance at the first words of a paragraph and immediately raise their eyes, whereupon they may tell "how much they saw."

The following suggestions are offered indicating the nature of the directions to be given to the pupils. Literal adherence to them is not requested. Point out the advantage of a rapid rate of reading. Try to get them to see this in terms of an addition to their own interests and pleasure. Say to them in substance: "I shall show you some cards containing words, phrases and sentences. They will be shown

for only a fraction of a second. So you will have to read them very quickly, with a single glance of the eyes. Try to read all that is printed on each card. You will have to pay very close attention when I show you the card, as otherwise you will not be able to read all that is on the card. This practice in reading a number of words at a glance will help you to read more rapidly. Try to do better than you did yesterday."

Spend about 15 minutes in perception card training. After each exposure ask some of the pupils to tell what was printed on the card. Toward the end of the training in perception, have all the pupils reproduce in writing what was on each of the five last cards exposed. The percentage of words correctly reproduced will constitute the pupils score in perception. State the total number of words exposed on the five cards and it will then be easy for each pupil to figure out his own score. Direct each pupil to enter his score immediately upon the chart that each pupil will keep for that purpose.

The second half of the period should now be devoted to rapid silent reading. The pupils should be encouraged to carry over the habit of "seeing many words at a glance," gained by their training in perception, into the actual work of silent reading. They should be directed to "run their eye across a line of words" as rapidly as they can, consistently of course, with an understanding of what they see. Throughout this reading period there should be a conscious effort to utilize the habit acquired through training in perception, by perceiving several words at each fixation, instead of but a single word. This should result in an increased rate of speed in silent reading.

Say to the pupils in substance: "Read this selection as fast as you[1] can. I want to see how much you can read in ——— minutes. Try to see as much as you can read in a single glance, running your eyes rapidly across the lines. A fast, regular, rhythmical movement of the eyes will help you to read rapidly. But remember that I am going to ask you to tell me about the matter you have read so do not skip anything. Try to read faster today than you did yesterday.

See that the pupils have a pencil at hand and direct them to stop reading at once as soon as you say "stop." Direct them then to mark the end the line which they are reading when told to stop. Pupils may now reproduce what they have read. Reproduction should consist both of free paraphrase—orally, or in writing—and of answers to specific questions based on the test. The length of the reading period and

[1] Number of minutes, say 2, 3 or 4, to be determined by the teacher.

of the reproduction period should vary with the grade of the pupils and with the subject matter. In general, however, the reproduction should not occupy more than one quarter of the total time allowed for the exercise. Reading and reproduction are to be continued till the end of the 15 minutes assigned. Have the pupils then report the number of pages and lines beyond the last full page which they read.

As part of your preparation for the exercise you will be expected to know the average number of words per line in the matter which is being read and the number of lines per page (if pages are broken by illustrations or for other reasons, special account of these pages will have to be taken). From the pupils' reports as to pages and lines read on this subsequent assignments for the day, estimate the number of words read that day and divide by the total number of minutes used in reading. This will give the number of words read per minute by each pupil. Each student should figure out his own score, and should enter it immediately on the chart on which he has already written his perception score. This chart will thus serve as a record of the pupil's daily progress. It is also suggested that a complete chart of the daily class performance might be conspicuously displayed in the class-room.

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A COMPARISON OF RESULTS OBTAINED BY THE TERMAN BINET TESTS AND THE HEALY PICTURE COMPLETION TEST

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The following study was made to determine, if possible, to what extent the Terman Binet and Healy Picture Completion Tests give identical results. In case they do not give identical results we are put frankly face to face with a number of facts which cannot be over looked in mental testing work and particularly in our concept of "general intelligence."

The report is based upon 65 cases, the great majority of which are below the Normal or average in the mental age by the Terman Binet scale. The writer wishes to acknowledge his obligation to Professor Jackson, of the Department of Education, University of Michigan, who kindly loaned the Binet ratings of 26 of the cases. The writer was thus saved the trouble and time of testing these 26 cases by the Binet Scale, merely having to give the Healy tests personally. (The difference in elapsed time was, of, course, provided for.) The other 39 cases were selected from the writer's personal record book.

Twenty six of the children tested were in the ungraded class in the Ann Arbor, Mich. Perry School. The rest of the children were cases tested by the writer in his work as mental tester for the Social Service Dept., University Homeopathic Hospital, Ann Arbor. Practically all the children tested are under the chronological age of 14, most of them being grouped between the age of 8 and 14 years.

The procedure and standards laid down by Pintner and Anderson for the Picture Completion Test were followed. As the test is relatively useless for adults, no adult cases appear in this report.

Inasmuch as only a study of each individual case can really show adequately the comparisons, we have given our results in detail.

Approaching the data first from an angle of very rough comparison, we have arranged all cases under both Tests into three general groups, (1) those cases testing in mental age below their chron. age, (2) those testing at age or normal, and (3) those advanced in mental age. Using this general grouping we find that, of the 65 cases recorded:

29 or 44.44 per cent stand in the same rough classification by each test;

19 or 29.23 per cent stand with diametrically opposed rating (*e.g.* Inferior-super.).

17 or 26.15 per cent stand differently classed (*e.g.* normal and superior).

Subject	Chron. age	Sex	Terman Binet Rating			Healy Picture Test		
			Ment. age	I.Q.	Class.	Score	Time	Class
1	10- 9	M	7- 4	69	F. M.	588	6′ 30″	Adult
2	10- 7	M	9- 2	87	Dull	518	5′ 00″	Adult
3	10- 4	F	8- 8	84	Dull	127	4′ 00″	Age 7
4	10- 9	F	7- 6	70	Border	7	0′ 00″	Age 5
5	10- 0	M	7- 0	70	Border	241	4′ 30″	Age 8
6	5- 0	F	5- 5	107	Normal	3	0′ 00″	Below 5
7	9- 0	M	9- 0	100	Normal	258	2′ 00″	Age 8
8	14- 4	M	11- 4	80	Dull	581	7′ 00″	Adult
9	14- 8	M	10-10	74	Border	444	4′ 34″	Age 15
10	11- 5	F	7- 0	62	F. M.	502	3′ 05″	Adult
11	13- 8	F	9- 1	70	Border	222	5′ 45″	Age 8
12	9- 0	F	7- 4	82	Dull	134	4′ 45″	Age 6
13	12- 6	M	9- 5	76	Border	509	7′ 57″	Adult
14	9-10	M	8- 7	88	Dull	464	6′ 20″	Adult
15	6- 0	M	6- 0	100	Normal	65	8′ 32″	Age 6
16	7- 6	F	7- 6	100	Normal	204	19′ 24″	Age 8
17	11- 6	M	7- 4	64	F. M.	421	4′ 04″	Age 13
18	12- 2	M	9-10	80	Dull	578	6′ 33″	Adult
19	8- 6	M	7- 4	87	Dull	261	3′ 41″	Age 8
20	8- 8	M	9- 0	104	Normal	483	3′ 00″	Adult
21	12- 9	F	9- 1	70	Border	95	0′ 00″	Age 6
22	11- 0	M	8- 6	70	Border	646	2′ 05″	Adult
23	14- 0	M	8-10	61	F. M.	449	3′ 00″	Age 15
24	15- 0	M	11- 1	73	Border	417	5′ 00″	Age 13
25	20- 0	F	8- 2	51	F. M.	326	7′ 00″	Age 10
26	14- 0	M	9- 2	62	F. M.	566	2′ 05″	Adult
27	12- 0	M	6- 8	52	F. M.	343	21′ 00″	Age 15
28	14- 0	M	8- 3	57	F. M.	583	1′ 05″	Adult
29	13- 0	M	10- 6	78	Border	380	2′ 00″	Age 11
30	10- 0	F	8- 7	85	Dull	583	4′ 00″	Adult
31	15- 0	M	7- 0	42	F. M.	437	2′ 05″	Age 14
32	14- 0	M	8- 4	53	F. M.	88	2′ 05″	Age 8
33	13- 0	F	10- 3	75	Border	646	4′ 05″	Adult
34	13- 0	M	8-10	66	F. M.	479	4′ 05″	Adult
35	14- 0	F	9- 0	62	F. M.	395	4′ 05″	Age 14
36	13- 0	M	9- 7	75	Border	502	7′ 00″	Adult
37	14- 0	M	11- 7	82	Dull	646	4′ 00″	Adult
38	15- 0	M	9- 1	61	F. M.	257	2′ 30″	Age 8
39	13- 0	M	7- 8	71	Border	308	7′ 30″	Age 9
40	14-10	M	8- 6	57	F. M.	324	2′ 55″	Age 9
41	13-11	M	6-10	50	F. M.	242	3′ 32″	Age 8
42	14- 8	M	8- 0	56	F. M.	63	5′ 20″	Age 6
43	15- 2	M	10- 0	70	Border	500	3′ 00″	Adult
44	15- 0	M	11- 4	76	Border	509	2′ 55″	Adult
45	13- 0	F	11- 1	85	Dull	333	2′ 30″	Age 10
46	15-10	M	11- 3	86	Dull	591	2′ 30″	Adult
47	13- 5	M	9- 5	71	Border	351	3′ 20″	Age 10
48	8- 4	M	7-11	95	Normal	419	0′ 00″	Age 13
49	11- 0	M	10-10	99	Normal	583	0′ 00″	Adult
50	8- 5	M	8- 2	97	Normal	502	0′ 00″	Adult
51	8- 9	F	12- 7	144	V. Super	578	0′ 00″	Adult
52	12- 6	F	15- 9	126	Super	583	0′ 00″	Adult
53	15- 5	F	9-10	64	F. M.	403	0′ 00″	Age 12
54	11- 2	F	9- 1	81	Dull	251	0′ 00″	Age 8
55	6- 0	F	4- 8	78	Border	000	0′ 00″	Below 5
56	19- 0	F	12- 0	75	Border	518	0′ 00″	Adult
57	13- 6	F	14- 4	107	Normal	509	0′ 00″	Adult
58	10- 0	M	7- 9	78	Border	10	0′ 00″	Age 5
59	20- 3	F	11- 0	70	Border	583	6′ 00″	Adult
60	9- 0	F	.....	100	Normal	429	0′ 00″	Age 13
61	11- 0	M	7- 6	69	F. M.	262	6′ 08″	Age 8
62	11- 0	M	7- 3	66	F. M.	446	4′ 06″	Age 15
63	9- 6	M	9-10	104	Normal	473	5′ 44″	Adult
64	12- 8	F	9- 6	75	Border	436	6′ 03″	Age 15
65	11-10	M	16- 3	138	V. Super	489	3′ 36″	Adult

However, these facts can better be stated by making but two statements as follows: of the 65 cases:

29 or 44.44 per cent give the same "rough" classification.

36 or 55.56 per cent give different classification.

The same thing may be briefly tabulated in a rough correlation table as follows:

Terman Binet Rating	Healy Picture Completion			
	Superior	Normal	Inferior	Total
Superior	3	0	0	3
Normal	7	2	2	11
Inferior	21	8	22	51
Total	31	10	24	65

If we now work out the coefficients of correlation by the products moment method we find.

The correlation between Binet I.Q. and Healy Score: $r = +.15 \pm 082$.
The correlation between Binet I.Q. and Healy Time: $r = -.05 \pm 093$.

Again we note the same facts stated above. The correlation between the Binet Standing and the Healy Picture Completion scores is insignificant, the probable error being twice as large as r. The same thing is true in comparing the Binet Scores and the Healy Picture Time records, only here is a negative correlation.

What is the significance of these results? Apparently one thing is demonstrated, namely, that the two types of tests are testing something very different. Are they both "General Intelligence" tests? If so then we must at once admit that our conception of general intelligence is capable of being split up into KINDS of general intelligence, or deny that one of the tests is really testing general intelligence.

One of the most suggestive papers the writer has read during the past year is that by Thorndike.[1] He notes that we may conceive of general intelligence (1) as an abstract, (2) as a concrete and mechanical, and (3) as a social general intelligence. While we do not believe that one is justified in making a "social" general intelligence (it seems to be making more confusion in a concept that is already sufficiently confusing), we believe that there is ground for the twofold general grouping. Our results indicate that the Picture Completion test is the concrete and more mechanical form of test—it tests this "concrete" form of general intelligence. On the other hand the Terman Binet tests tap the "abstract" form of general intelligence far more.

That the Picture Completion test is easier seems evident from our data. Of the 65 cases, 34 get advanced standing (of their chrono-

[1] Intelligence and Its Uses, *Harpers*, Jan., 1920.

logical age) by the Healy test, while only two cases actually test below the Binet rating. If a child ranks at a given age by the Healy Picture Completion test, then he, in all likelihood, will test below age by the Binet (especially for children of lower mentality).

In a series of studies in the public school which the writer has made recently, using the Picture Completion test and other performance tests, it was noted that the children who did well on the Binet tests, did well in school work demanding abstract thinking, as arithmetic, and language, whereas this did not at all follow when the child stood even much advanced by the performance tests.

Time and again we have found a child definitely feebleminded by the Binet scale and three or four years advanced by the Picture Completion test. That the results of the tests warrant a conception of a two-aspect general intelligence seems reasonable.

We are all familiar with the individual who does well in concrete situations. The boy does well in the manual training room, surrounded by concrete objects, but is utterly incapable of following out any line of abstract thought. We all know the "common sense" person, the good substantial citizen possibly, who can't engage in abstract thinking to save himself. These people do well on such a test as the Picture Completion Test.

One might dare theorize somewhat as follows: in the evolution of the race the ability to engage in abstract thinking, to handle abstractions, is the very acme of mental development—it is a step past the more primitive concrete mind! We believe we are dealing with more than a mere difference in training here, also. If the preceding statement is at all valid, we might very well place the ability shown in the Terman Binet Tests above that shown in the Performance test; indeed we would seem justified in regarding the abstract form of general intelligence as superior to the more concrete.

Summary

1. Extremely different ratings result from the Terman Binet and the Healy Picture Completion Tests.

2. The Picture Completion test is easier.

3. The tests seem to test different things, which suggests a concrete or inferior type of general intelligence, and an abstract or superior type or development of general intelligence.

4. As it is the abstract general intelligence that is taxed most in our schools, it is probable that performance tests are very inferior to the Terman Binet Tests, in the way of predicting the child's school career.